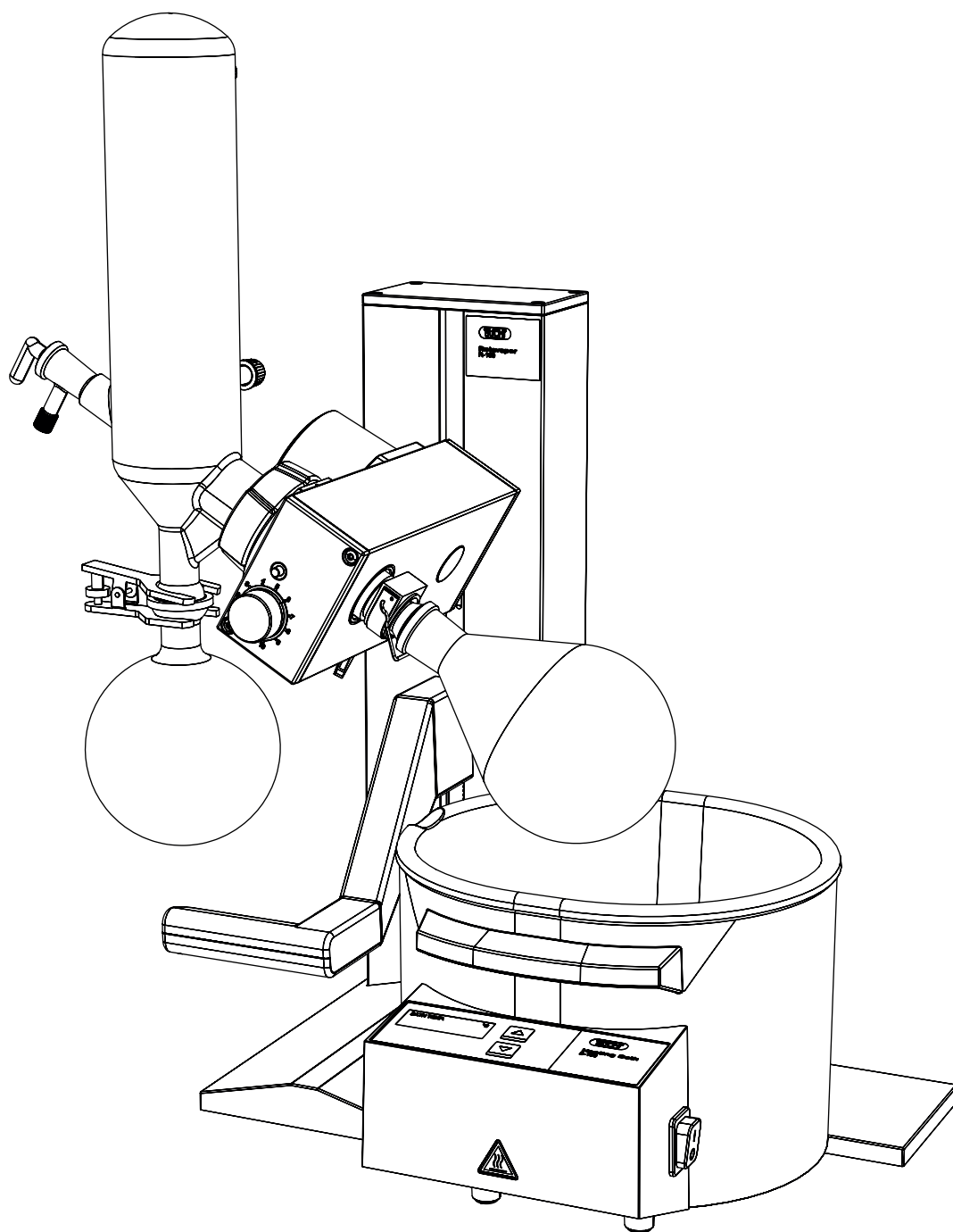




Rotavapor® R-100 Operation Manual



Imprint

Product Identification:
Operation Manual (Original) Rotavapor® R-100
11593663 en

Publication date:
12.2014, Version B

BÜCHI Labortechnik AG
Meierseggstrasse 40
Postfach
CH-9230 Flawil 1

E-Mail: quality@buchi.com

BÜCHI reserves the right to make changes to the manual as deemed necessary in the light of experience; especially in respect to structure, illustrations and technical detail.

This manual is copyrighted. Information from it may not be reproduced, distributed, or used for competitive purposes, nor made available to third parties. The manufacture of any component with the aid of this manual without prior written agreement is also prohibited.

Contents

1	About this document.....	5
1.1	Warning notices in this document.....	5
1.2	Symbols	5
1.2.1	Warning symbols	5
1.2.2	Mandatory directive symbols	6
1.2.3	Other symbols.....	6
1.3	Available languages.....	6
1.4	Trademarks.....	6
2	Safety	7
2.1	Intended use	7
2.2	Use other than that intended	7
2.3	Staff qualification	8
2.4	Residual risks	8
2.4.1	Dangerous vapors.....	8
2.4.2	High internal pressure	9
2.4.3	Hot surfaces and liquids.....	9
2.4.4	Glass breakage.....	9
2.4.5	Rotating parts.....	9
2.4.6	Faults during operation	9
2.5	Personal protective equipment	9
2.6	Modifications.....	10
3	Product description.....	11
3.1	Description of function	11
3.2	Configuration	12
3.2.1	Front view	12
3.2.2	Rear view	13
3.2.3	Heating bath user interface.....	13
3.2.4	Typical application	14
3.2.5	Type plate	15
3.2.6	Warning symbols on the device	16
3.3	Specifications supplied	16
3.4	Technical data	17
3.4.1	Rotavapor® R-100	17
3.4.2	Heating bath B-100	17
3.4.3	Ambient conditions.....	18
3.4.4	Materials	18
3.5	Safety features.....	19
3.5.1	Overheat cut-out	19
3.5.2	Protection against electrical overload	19
3.5.3	Clips and holders	19
3.5.4	Glassware	19
3.5.5	Optional accessories.....	19
4	Transport and storage	20
4.1	Transport	20
4.2	Storage	20

5	Installation.....	21
5.1	Installation site	21
5.2	Mounting the rotary drive unit	21
5.3	Fitting the vapor duct and condenser	22
5.4	Fitting the glass stopcock	23
5.5	Connecting the vacuum and cooling media tubing	24
5.6	Electrical connections	25
5.7	Overview of connections.....	25
5.8	Setting up and filling the heating bath.....	26
5.9	Quick check	26
6	Operation.....	27
6.1	Preparations	27
6.1.1	Preparing the heating bath.....	27
6.1.2	Fitting the evaporating flask	28
6.1.3	Adjusting immersion angle of evaporating flask.....	29
6.1.4	Fitting the receiving flask	30
6.1.5	Vertical adjustment	30
6.2	Performing distillation	32
6.2.1	Raising and lowering the evaporating flask	33
6.2.2	Adjusting distillation conditions	34
6.2.3	Optimization distillation	35
6.2.4	Feeding solvent during distillation.....	36
6.3	Finishing distillation.....	37
6.3.1	Removing the evaporating flask.....	37
6.3.2	Removing the receiving flask	38
7	Cleaning and servicing	39
7.1	Inspecting and cleaning the vapor duct	39
7.2	Checking the system for leaks.....	39
7.3	Checking seals	40
7.4	Cleaning the condenser.....	40
7.5	Cleaning the heating bath.....	41
7.6	Removing solvent accumulations	41
8	Help with faults	42
8.1	Faults, possible causes and remedies.....	42
8.2	Remedy	44
8.2.1	Resetting overheat safety cut-out	44
8.2.2	Replacing the fuse	45
9	Taking out of service and disposal.....	46
9.1	Taking out of service.....	46
9.2	Disposal	46
10	Appendix	47
10.1	Solvent table	47
10.2	Spare parts and accessories	48
10.2.1	Glass apparatus V	49
10.2.2	Glass apparatus C	50
10.2.3	Accessories.....	51
10.2.4	Wear parts	55
10.2.5	Spare parts	56
10.3	List of abbreviations.....	57
10.4	Health and safety approval	57
10.5	Health and safety.....	58

1 About this document

These operating instructions describe the Rotavapor® R-100 at the time supplied. They are an integral part of the product and contain important information that is necessary for safe operation and maintenance.

These operating instructions apply to all variants of the Rotavapor® R-100 and are intended primarily for laboratory staff.

- ▶ To ensure safe and trouble-free operation, read these operating instructions before starting up the device and follow the guidance they contain.
- ▶ Keep the operating instructions somewhere near to the device.
- ▶ Pass on the operating instructions to any subsequent owner or user.

BÜCHI Labortechnik AG accepts no liability whatsoever for any faults or damage that result from the failure to follow these operating instructions.

- ▶ If you still have any questions after reading these operating instructions, please contact BÜCHI Labortechnik AG Customer Service. Contact details for your local agents can be found on the back cover of these operating instructions or on the Internet at <http://www.buchi.com>.

1.1 Warning notices in this document









Warning notices warn you of dangers that can occur when handling the device. There are four danger levels, each identifiable by the signal word used.





Signal word	Meaning
DANGER	Indicates a danger with a high level of risk which could result in death or serious injury if not prevented.
WARNING	Indicates a danger with a medium level of risk which could result in death or serious injury if not prevented.
CAUTION	Indicates a danger with a low level of risk which could result in minor or medium-severity injury if not prevented.
IMPORTANT	Indicates a danger that could result in damage to property.

1.2 Symbols





The following symbols may be displayed in this instruction manual or on the device:

1.2.1 Warning symbols

Symbol	Meaning	Symbol	Meaning
	General warning		Corrosive substance
	Dangerous electrical voltage		Flammable substance
	Biological hazard		Potentially explosive atmosphere
	Breakable items		Dangerous gases

Symbol	Meaning	Symbol	Meaning
	Hot surface		Health-harming or irritant substances
	Risk of hand injury		Strong magnetism

1.2.2 Mandatory directive symbols

Symbol	Meaning	Symbol	Meaning
	Wear safety goggles		Wear protective clothing
	Wear protective gloves		Heavy load, do not lift without assistance

1.2.3 Other symbols



NOTE

This symbol draws attention to useful and important information.

- ☒ This character draws attention to a requirement that must be met before the instructions below are carried out.
- This character indicates an instruction that must be carried out by the user.
- ☐ This character indicates the result of a correctly carried out instruction.

1.3 Available languages

These operating instructions were originally produced in German and have been translated into several other languages. The translations are available on the enclosed CD or can be obtained as a PDF file via <http://www.buchi.com>.

1.4 Trademarks

Product names and registered or unregistered trademarks that are used in this instruction manual are used only for identification and remain the property of the owner in each case.

Rotavapor® is a registered trademark of BÜCHI Labortechnik AG.

2 Safety

2.1 Intended use

The Rotavapor® R-100 is intended for evaporating and condensing solvents. It can be used in laboratories and production facilities for the following operations:

- Evaporating and condensing solvents and suspensions
- Synthesis and purification of refined chemicals
- Recycling and concentration of solvents
- Recrystallization
- Drying of powders and granulates

2.2 Use other than that intended

Use of any kind other than that described in the section Chapter 2.1 "Intended use", page 7 and any application that does not comply with the technical specifications (see Chapter 3.4 "Technical data", page 17) constitutes use other than that intended.

In particular, the following applications are not permissible:

- Use of the device in an environment with a potential risk of explosion or areas which require explosion-safe apparatus
- Use of the device for processing substances in the food, animal feed or cosmetics industries
- Production and processing of substances that can lead to spontaneous reactions, e.g. explosives, metal hydrides or solvents that can form peroxides
- Working with explosive gas mixtures
- Distillation of oil
- Drying hard, brittle substances (e.g. stone or soil samples) that could damage the evaporating flask
- Shock-cooling of the evaporating flask or other glass components

Damage or hazards attributable to use of the product other than as intended are entirely at the risk of the user alone.

2.3 Staff qualification

Unqualified persons are unable to identify risks and are therefore exposed to greater dangers.

The device may only be operated by suitably qualified laboratory staff.

These operating instructions are aimed at the following target groups:

Users

Users are persons that meet the following criteria:

- They have been instructed in the use of the device.
- They are familiar with the contents of these operating instructions and the applicable safety regulations and apply them.
- They are able on the basis of their training or professional experience to assess the risks associated with the use of the device.

Operator

The operator (generally the laboratory manager) is responsible for the following aspects:

- The device must be correctly installed, commissioned, operated and serviced.
- Only suitably qualified staff may be assigned the task of performing the operations described in these operating instructions.
- The staff must comply with the locally applicable requirements and regulations for safe and hazard-conscious working practices.
- Safety-related incidents that occur while using the device should be reported to the manufacturer (quality@buchi.com).

BUCHI service technicians

Service technicians authorized by BUCHI have attended special training courses and are authorized by BÜCHI Labortechnik AG to carry out special servicing and repair measures.

2.4 Residual risks

The device has been developed and manufactured using the latest technological advances. Nevertheless, risks to persons, property or the environment can arise if the device is used incorrectly.

Appropriate warnings in this manual serve to alert the user to these residual dangers.

2.4.1 Dangerous vapors

Distillation can produce dangerous vapors that are capable of causing life-threatening toxic effects.

- ▶ Do not inhale any vapors produced during distillation.
- ▶ Ensure that vapors are removed immediately by a suitable fume hood.
- ▶ Only use the device in well ventilated areas.
- ▶ If vapors escape from joints or connections, check the seals concerned and replace them if necessary.
- ▶ Do not distill any unknown fluids.
- ▶ Observe the safety data sheets for all fluids used.

2.4.2 High internal pressure

The evaporation of fluids can produce high pressures inside the flask or the condenser. If that pressure becomes too great, the glass components could explode.

- ▶ Make sure that the internal pressure inside the glass components is never greater than atmospheric pressure.
- ▶ When distilling without a vacuum, set the vacuum pump to atmospheric pressure so that excess pressure is automatically dissipated.
- ▶ If a vacuum pump is not used, leave the vacuum connection open.

2.4.3 Hot surfaces and liquids

The heating bath, evaporating flask and parts of the condenser can become very hot. If touched they can cause skin burns.

- ▶ Do not touch hot surfaces or liquids or else wear suitable protective gloves.

2.4.4 Glass breakage

Broken glass can cause severe cuts.

Damaged glass components may implode if subjected to a vacuum.

Minor damage to the ground joints impairs the sealing effect and may therefore reduce diminish distillation capacity.

- ▶ Handle the flask and other glass components carefully and do not drop them.
- ▶ Always place the flasks in a suitable holder when they are not mounted on the Rotavapor.
- ▶ Always visually inspect glass components for damage every time they are to be used.
- ▶ Do not continue to use glass components that are damaged.
- ▶ Always wear protective gloves when disposing of broken glass.

2.4.5 Rotating parts

The evaporating flask and the vapor duct are rotated by the rotary drive unit. Hair, clothing or jewelry can become caught up if allowed to come into contact with the rotating parts.

At high speeds, the heating fluid may be sprayed out by the rotation of the evaporating flask.

- ▶ Wear work overalls or protective clothing.
- ▶ Do not wear loose or baggy items of clothing such as scarves or neck-ties.
- ▶ Tie up long hair.
- ▶ Do not wear jewelry such as necklaces or bracelets.
- ▶ At high speeds and/or high temperatures, use the optional safety guard or a similar protective arrangement.

2.4.6 Faults during operation

If a device is damaged, sharp edges or exposed electrical wires can cause injuries.

- ▶ Regularly check device for visible damage.
- ▶ If faults occur, switch off the device immediately, unplug the power cord and inform the operator.
- ▶ Do not continue to use devices that are damaged.

2.5 Personal protective equipment

Depending on the application, hazards due to heat and/or corrosive chemicals may arise.

- ▶ Always wear appropriate personal protective equipment such as safety goggles, protective clothing and gloves.
- ▶ Make sure that the personal protective equipment meets the requirements of the safety data sheets for all chemicals used.

2.6 Modifications

Unauthorized modifications may impair safety and lead to accidents.

- ▶ Use only genuine BUCHI accessories, spare parts and consumables.
- ▶ Technical modifications to the device or accessories should only be carried out with the prior written approval of BÜCHI Labortechnik AG and only by authorized BUCHI technicians.

BUCHI accepts no liability whatsoever for damage arising as a result of unauthorized modifications.

3 Product description

3.1 Description of function

The Rotavapor® R-100 is a rotary evaporator with the aid of which single-stage distillation can be carried out quickly without unduly stressing the product. The basis of the process is the evaporation and condensing of solvents using a rotating evaporating flask under vacuum. Distillation under vacuum increases capacity and is more gentle on the product.

The product is heated in the evaporating flask by the heating bath. The rotary drive unit evenly rotates the evaporating flask. This constantly mixes the product, thereby increasing the evaporation rate. Rotation also prevents localized overheating and delayed evaporation.

The vapor passes from the evaporating flask through the vapor duct into the cooling section (condenser). There, the thermal energy of the vapor is transferred to the coolant fluid so that the vapor re-condenses. The resulting solvent is collected in the receiving flask and can then be reused or properly disposed of.

Distillation under vacuum

The distillation capacity depends on the temperature of the heating bath, the pressure in the evaporating flask, the speed of rotation and the size of the evaporating flask. Lower pressure, i.e. more vacuum, reduces the boiling point of the solvent so that it requires less heating. That means that it can be distilled more gently and at a faster evaporation rate than processes carried out under normal ambient conditions.

To prevent undesirable solvent emission and delayed evaporation, the vacuum has to be adjusted to suit the application and kept stable. This can be achieved by means of a vacuum pump (we recommend the BUCHI Vacuum Pump V-100) controlled by a vacuum regulator (we recommend the BUCHI Interface I-100). We also recommend that the temperature difference between the coolant fluid and the heating bath is 40 °C (see Chapter 6.2.2 "Adjusting distillation conditions", page 34).

3.2 Configuration

3.2.1 Front view

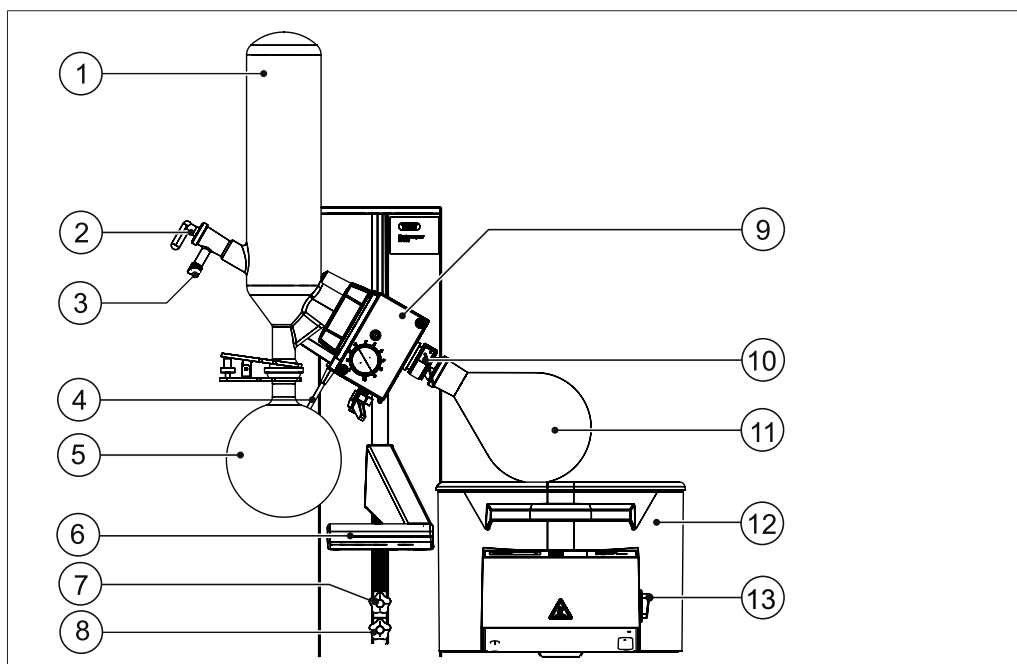


Fig. 1: Configuration of R-100 with V-condenser

- | | |
|--------------------------------------|----------------------|
| 1 Condenser | 9 Rotary drive unit |
| 2 Glass stopcock | 10 Combi-clip |
| 3 Solvent feeding | 11 Evaporating flask |
| 4 Power supply for rotary drive unit | 12 Heating bath |
| 5 Receiving flask | 13 Master switch |
| 6 Handle for height adjustment | |
| 7 Lower vertical stop | |
| 8 Vertical operating range adjuster | |

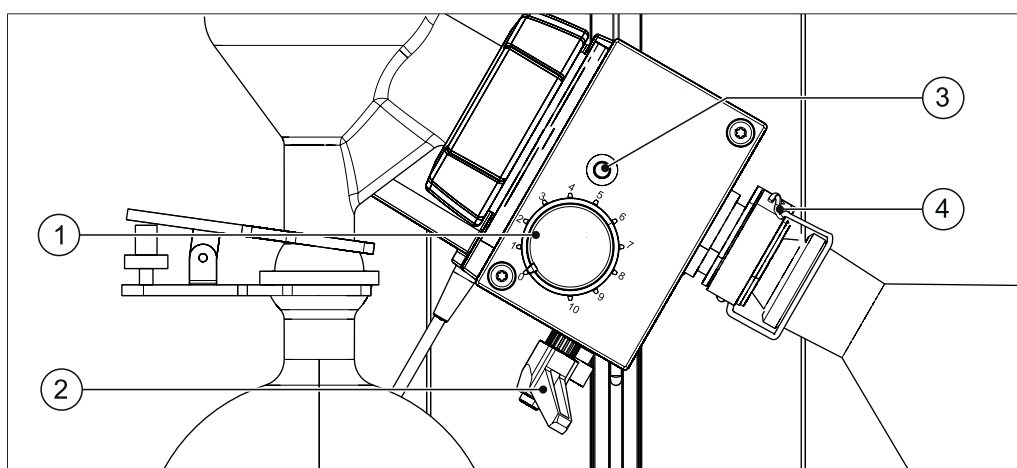


Fig. 2: Rotary drive unit

- | | |
|---------------------------------|-------------------------------|
| 1 Rotation speed control | 3 Rotary drive locking button |
| 2 Immersion angle locking lever | 4 Combi-clip |

3.2.2 Rear view

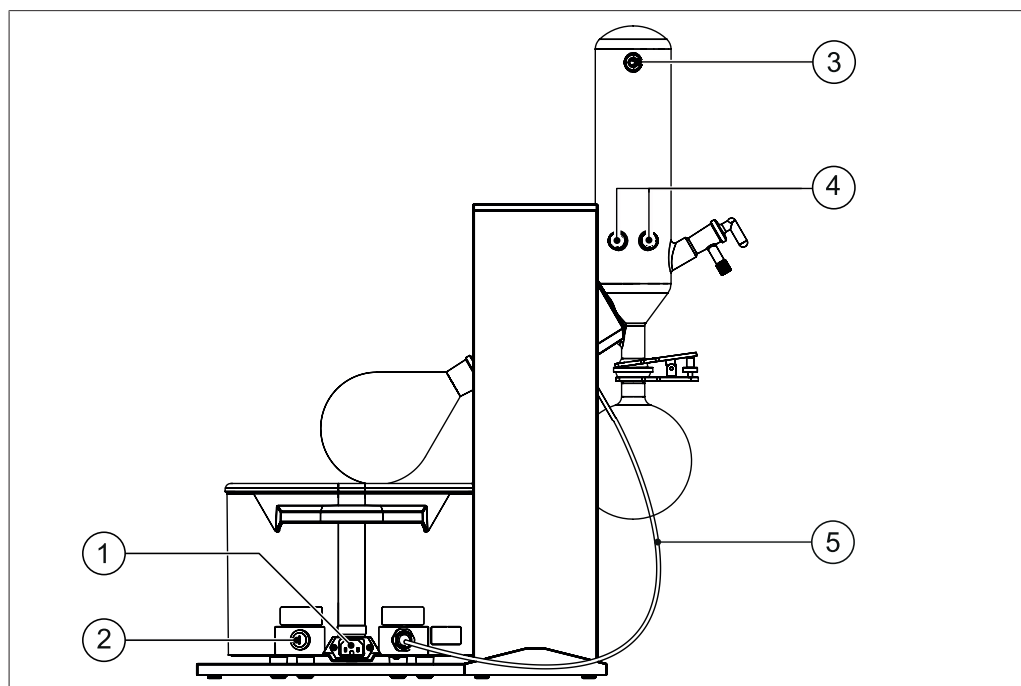


Fig. 3: Rear view R-100

- | | |
|---------------------------|--------------------------------------|
| 1 Power supply connection | 3 Vacuum connection |
| 2 Fuse | 4 Coolant fluid connection |
| | 5 Power supply for rotary drive unit |

3.2.3 Heating bath user interface

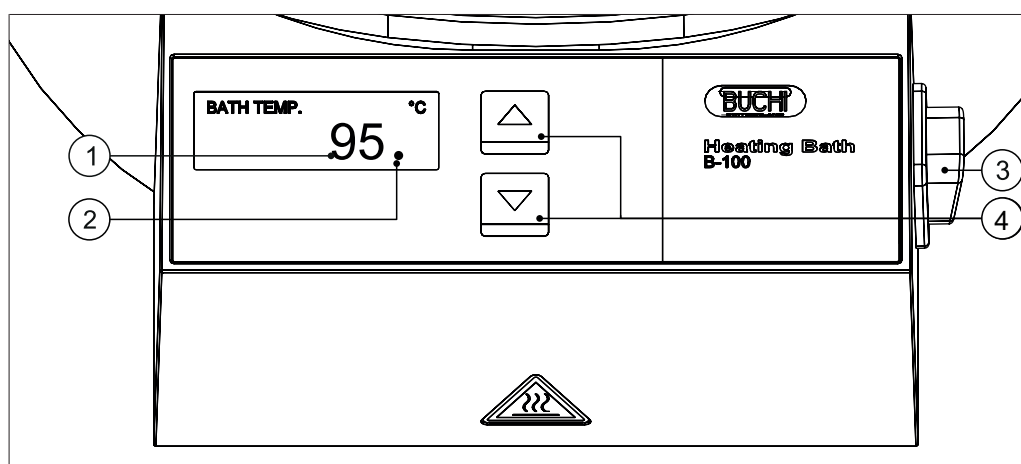


Fig. 4: Heating bath user interface

- | | |
|-----------------------------------|----------------------|
| 1 Temperature display | 3 Master switch |
| 2 Heating process indicator (dot) | 4 Adjustment buttons |

3.2.4 Typical application

In order to use the Rotavapor® R-100 to best effect, we recommend that it is used together with the following peripheral devices:

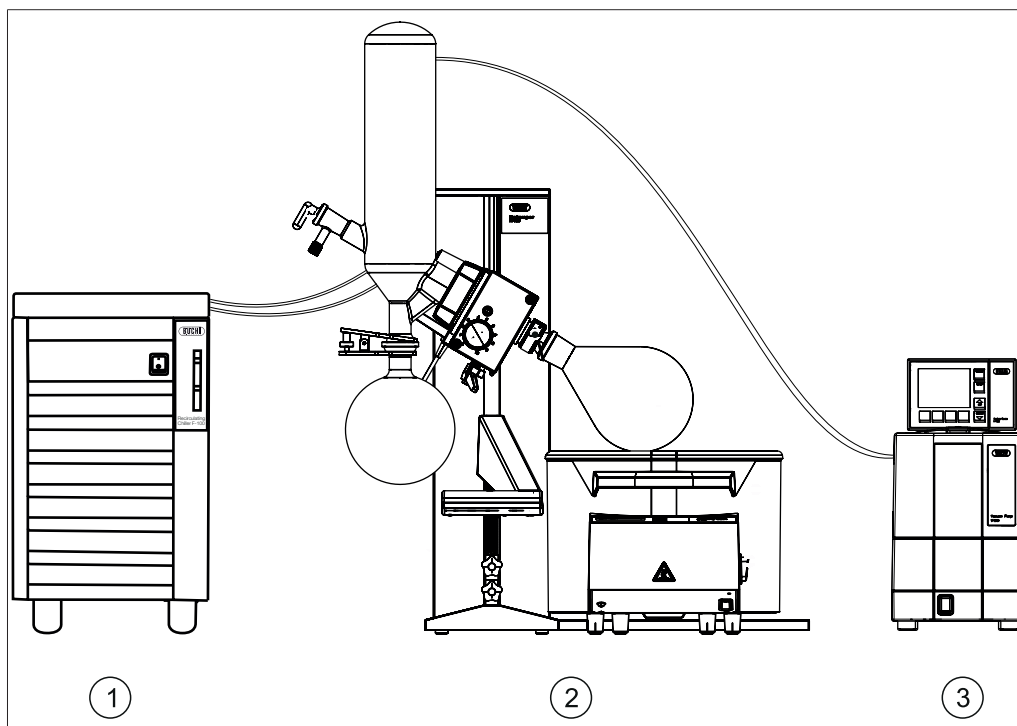


Fig. 5: Rotavapor® R-100 system

- 1 Recirculating Chiller F-100/F-105
- 2 Rotavapor® R-100
- 3 Vacuum Pump V-100 with Interface I-100

The Vacuum Pump V-100 is designed for evacuating laboratory apparatus with the aid of a PTFE membrane. It can be operated either as a standalone device or combined with optional accessories such as an interface unit and a secondary condenser to form a complete vacuum system.

The F-100 and F-105 are sealed-system recirculating chillers. They are available in various capacity ratings.

3.2.5 Type plate

The type plate is on the right-hand side of the Rotavapor® R-100.

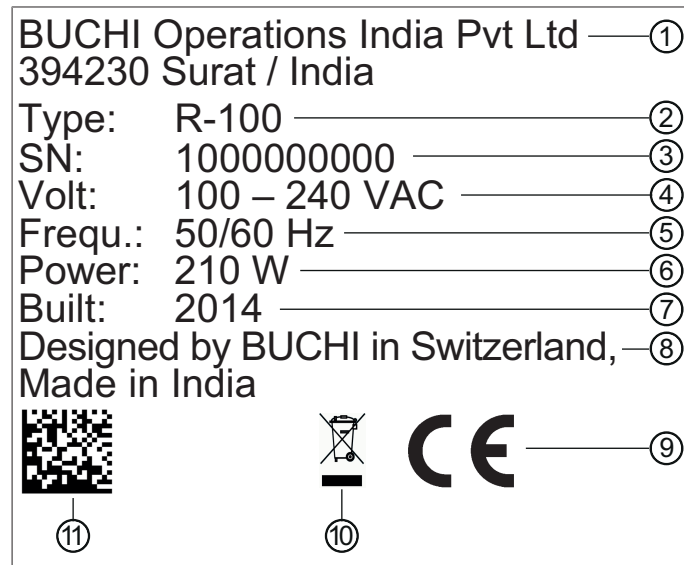
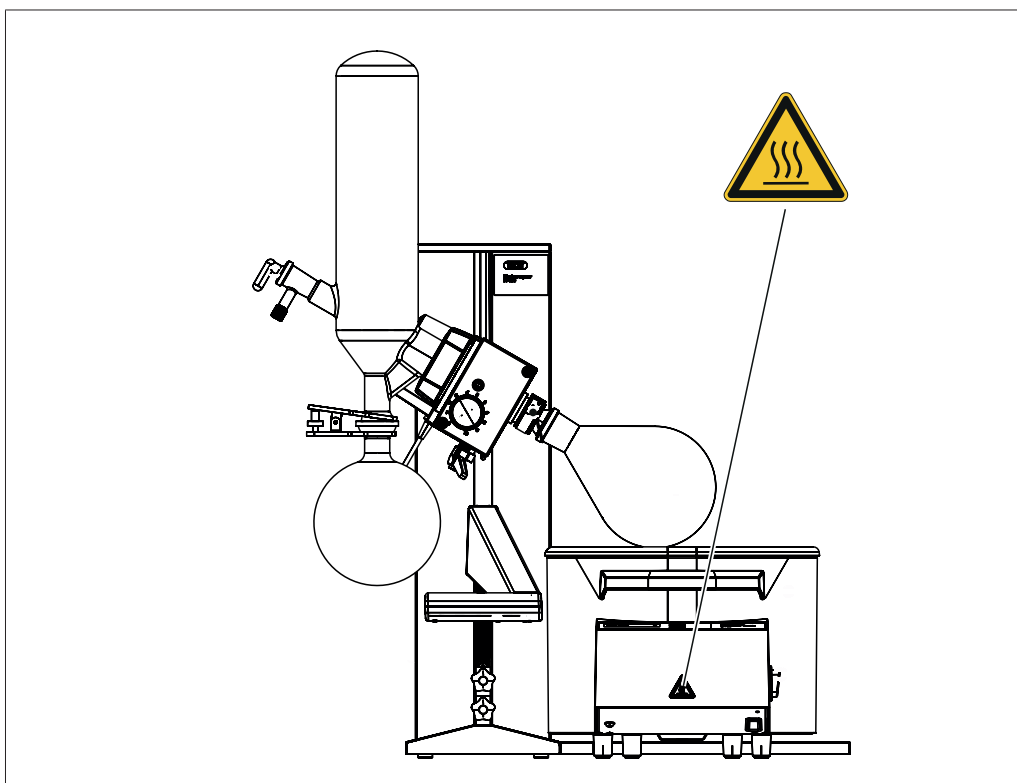


Fig. 6: Type plate (example)

- | | |
|----------------------------|--|
| 1 Company name and address | 7 Year of manufacture |
| 2 Device name | 8 Country of manufacture |
| 3 Serial number | 9 Approvals |
| 4 Input voltage | 10 Symbol for "Do not dispose of as household waste" |
| 5 Frequency | 11 Product code |
| 6 Maximum power rating | |

3.2.6 Warning symbols on the device

The device carries the following warning symbol:



3.3 Specifications supplied

	System with glassware	System without glassware
Rotavapor® R-100	1	1
Heating bath B-100	1	1
Condenser (as per order number)	1	–
Vapor duct (with combi-clip)	1	–
Vacuum seal (KD22)	1	1
Evaporating flask (1 litre)	1	–
Receiving flask (1 litre)	1	–
Solvents table flyer	1	1
Required coolant and vacuum tubing	1 set	–
Power cord	1	1

3.4 Technical data

3.4.1 Rotavapor® R-100

Dimensions (W x H x D)	617 x 898 x 502 mm (inc. condenser and heating bath) 480 x 626 x 502 mm (w/o condenser and heating bath)
Weight	18 – 19 kg (depending on glassware included)
Voltage	24 V DC
Power consumption	30 W
Enclosure rating	IP21
Immersion angle	0 – 35°
Adjustable height	150 mm (+ 100 mm optional extension)
Rotation speed	20 – 280 rpm
Flask size	50 – 4000 mL
Max. flask capacity	3 kg
Approval	CE

3.4.2 Heating bath B-100

Dimensions (W x H x D)	285 x 219 x 326 mm
Weight	3.9 kg
Voltage	100 – 120 V/220 – 240 V
Frequency	50 – 60 Hz
Power consumption	1700 W
Heater output	1300 W
Enclosure rating	IP21
Fuse	T 12.5 A L 250 V (100 – 120 V) T 6.3 A L 250 V (220 – 240 V)
Temperature range	20 – 95 °C
Max. flask size	4000 mL
Adjustment accuracy	± 1 %
Bath capacity	4 L
High temperature cut-out	> 145 °C
Approval	CE

3.4.3 Ambient conditions

Max. altitude above sea level	2000 m
Ambient temperature	10 – 40 °C
Maximum relative humidity	80 % for temperatures up to 31 °C decreasing linearly to 50 % at 40 °C

The Rotavapor® may only be used in indoor areas.

3.4.4 Materials

Component	Material
Rotavapor housing	Anodized aluminium with powder coating
Heating bath housing	PBT, partially glass-fiber reinforced
Heating bath	Stainless steel 1.4404, glass-peened
Safety guard	Polycarbonate
Guard ring (of safety guard)	PBT, partially glass-fiber reinforced
Rotary drive unit	Stainless steel 1.4305
Flange connection to condenser	Aluminium
Seal	NBR, PTFE

3.5 Safety features

3.5.1 Overheat cut-out

To protect against overheating, the heating bath has a thermostatic bath temperature control.

In addition it is fitted with an electronic and a mechanical overheat cut-out.

The electronic overheat cut-out monitors the temperature limit (the actual temperature of the bath must not exceed the specified temperature by more than 2 °C for longer than 2 minutes) the heating rate (the actual temperature must not increase by more than 5 °C within 5 seconds) and the function of the temperature sensor. If the electronic overheat cut-out trips, the device should be inspected by a BUCHI service technician.

The mechanical overheat cut-out consists of a bi-metallic thermostat that immediately cuts off the power supply at high temperatures (above 145 °C). The mechanical overheat cut-out has to be manually reset once the heating bath has cooled down (see Chapter 8.2.1 "Resetting overheat safety cut-out", page 44).

3.5.2 Protection against electrical overload

The heating bath is equipped with fuses to protect against electrical overload.

The rotary drive unit has an electrical overload cut-out.

3.5.3 Clips and holders

- Combi-clips for fixing the evaporating flask and safe release of sticking ground-glass joints
- Ball joint clamps for securely fixing the receiving flask
- Laboratory stand and holder for fixing glass apparatus
- Cap nut for fixing the condenser

3.5.4 Glassware

- High-quality borosilicate glass 3.3
- GL14 hose barbs for preventing glass breakage

3.5.5 Optional accessories

- Safety guard to protect user against glass splinters, solvent splashes or hot heating fluid in the event of accidents or implosions
- Laboratory stand for providing additional fixing for condenser

(see Chapter 10.2 "Spare parts and accessories", page 48)

4 Transport and storage

4.1 Transport

IMPORTANT

Risk of breakage due to incorrect transportation

- ▶ Make sure that the device is fully dismantled and all parts of the device are safely packed in such a way as to prevent breakage, ideally in the original box.
- ▶ Avoid sharp movements during transit.

-
- ▶ After transportation, check the device and all glass components for damage.
 - ▶ Damage that has occurred in transit should be reported to the carrier.
 - ▶ Keep packing for future transportation.

4.2 Storage

- ▶ Make sure that the ambient conditions are complied with (see Chapter 3.4 "Technical data", page 17).
- ▶ Wherever possible, store the device in its original packaging.
- ▶ After storage, check the device, all glass components, seals and tubing for damage and replace if necessary.

5 Installation

5.1 Installation site

The installation site must meet the following requirements:

- Firm and level surface
- Space requirements: at least 620 mm x 510 mm (W x D)
- If distilling under vacuum, there must be a fume hood available.

Wherever possible, the Rotavapor® R-100 should be set up inside the fume hood.

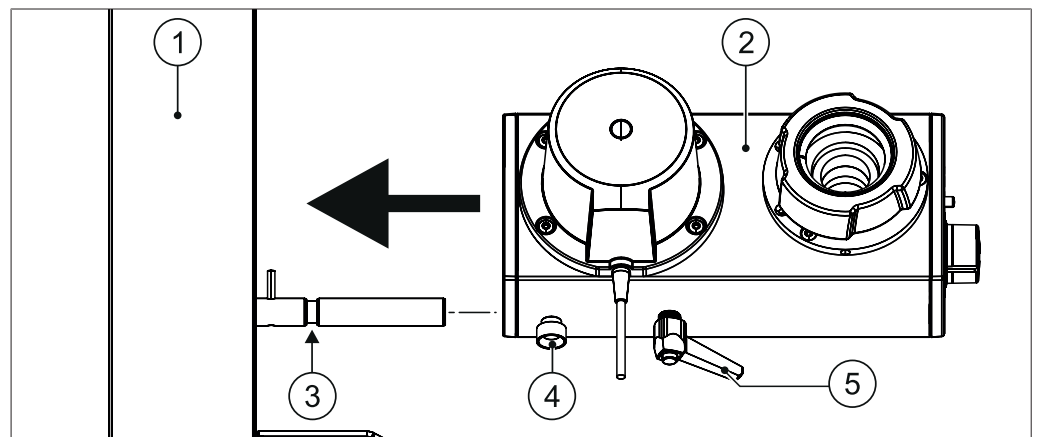
If that is not possible for reasons of space, it can also be set up outside if the safety guard (optional accessory) is fitted and the residual vapors are fed into the fume hood.

5.2 Mounting the rotary drive unit

IMPORTANT

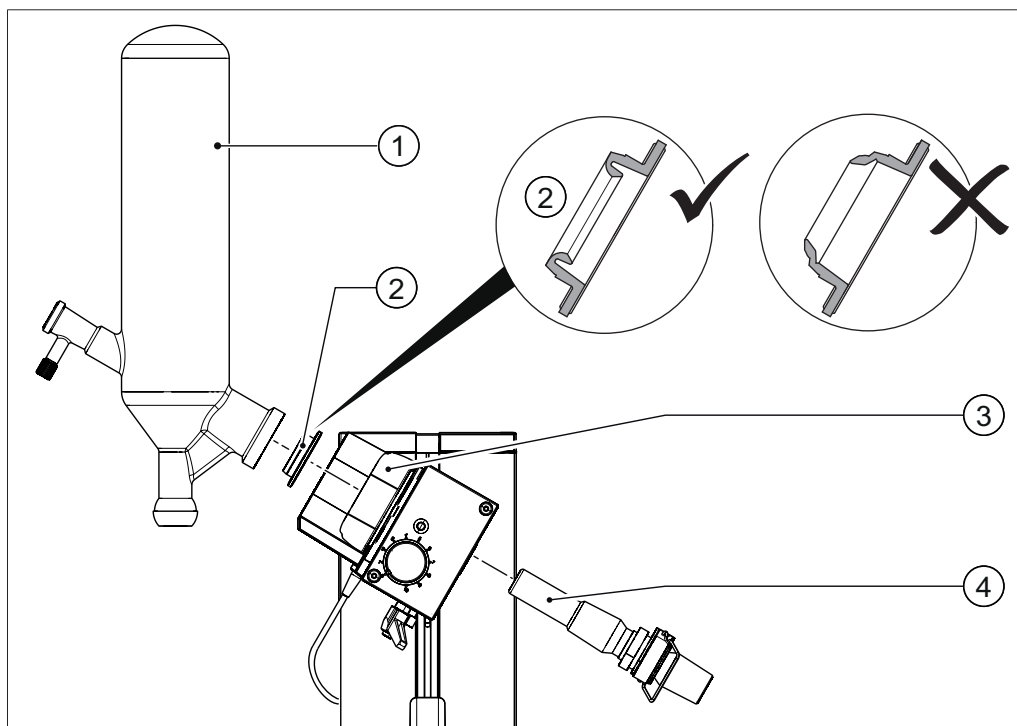
Risk of property damage due to rotary drive unit falling off

- Make sure that the screw for fixing the rotary drive unit engages securely in the groove in the tower mount.



- Slide rotary drive unit (2) onto the tower mount (1).
- Tighten screw (4) to lock the rotary drive unit in the groove (3) so that it cannot be pulled off.
- Tighten the locking lever (5) for the immersion angle.
- Check that the rotary drive unit cannot be pulled off or twisted.

5.3 Fitting the vapor duct and condenser

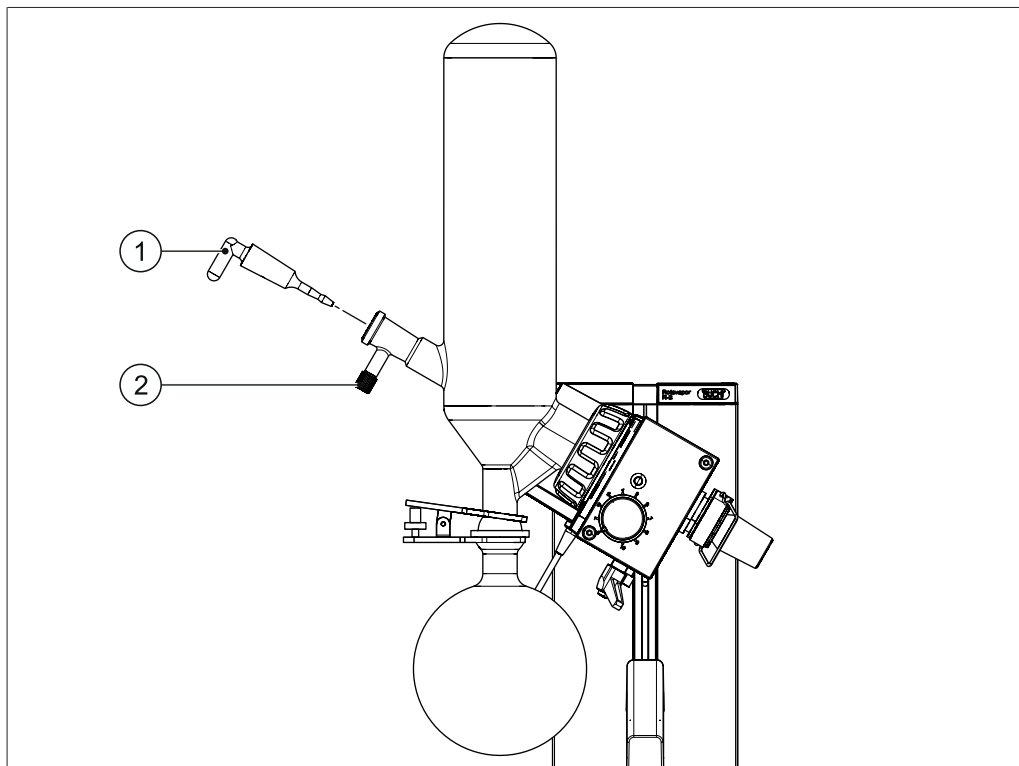


- ▶ Insert vapor duct (4) into the rotary drive unit.
The vapor duct snaps into place with an audible click.
- ▶ **NOTICE! Risk of seal damage if fitted incorrectly.** Insert seal (2) into the flange of the condenser (1) as shown.
- ▶ Fit condenser (1) into the rotary drive unit, keeping it straight as you do so. When doing so, make sure that the inner lip of the seal (2) does not fold over as the seal would then be destroyed.
- ▶ Tighten the cap nut (3) to fix the condenser in position. When doing so, make sure that the spring clip in the cap nut completely encircles the neck of the condenser.

5.4 Fitting the glass stopcock

Materials required:

- Grease Glisseal 40 blue (order number 048197)



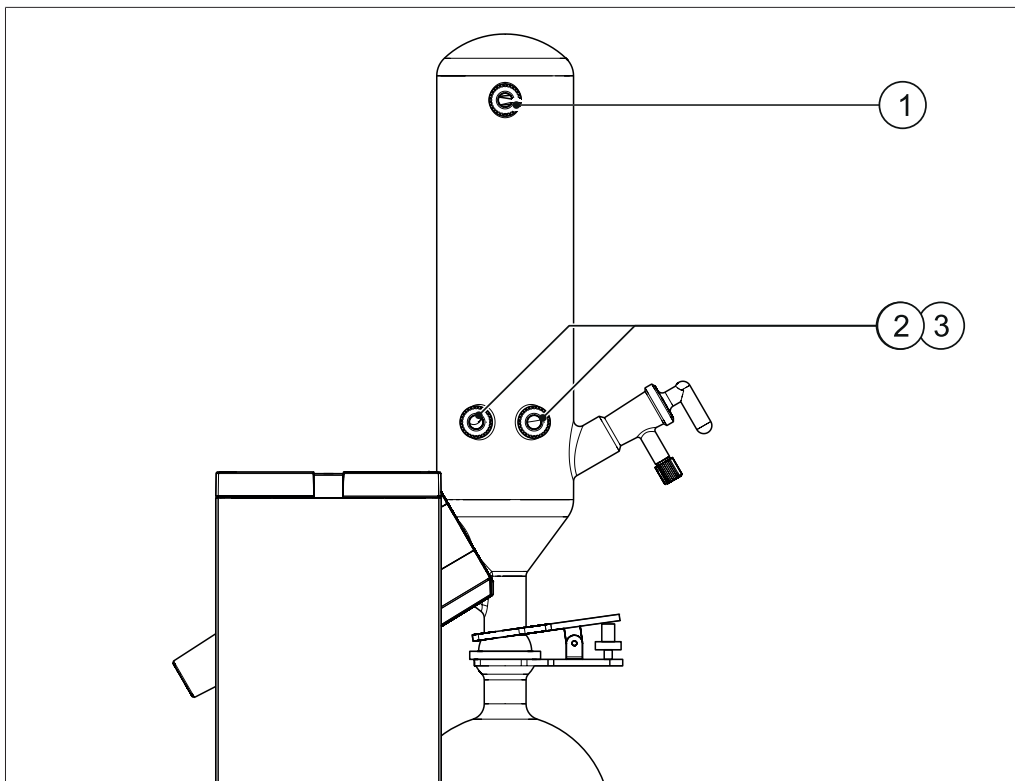
- ▶ Connect a supply tubing for solvent (2).
- ▶ Apply a thin coat of Grease Glisseal 40 blue to the glass stopcock (1).
- ▶ Insert glass stopcock into the condenser and turn to the desired position.

The glass stopcock performs various functions depending on its position:

- Glass stopcock handle pointing forwards or backwards: the system is sealed. This is the standard position for distillation.
- Glass stopcock handle pointing upwards: system is being vented.
- Glass stopcock handle pointing downwards: additional solvent can be fed into the evaporating flask via a connected feeding tubing.

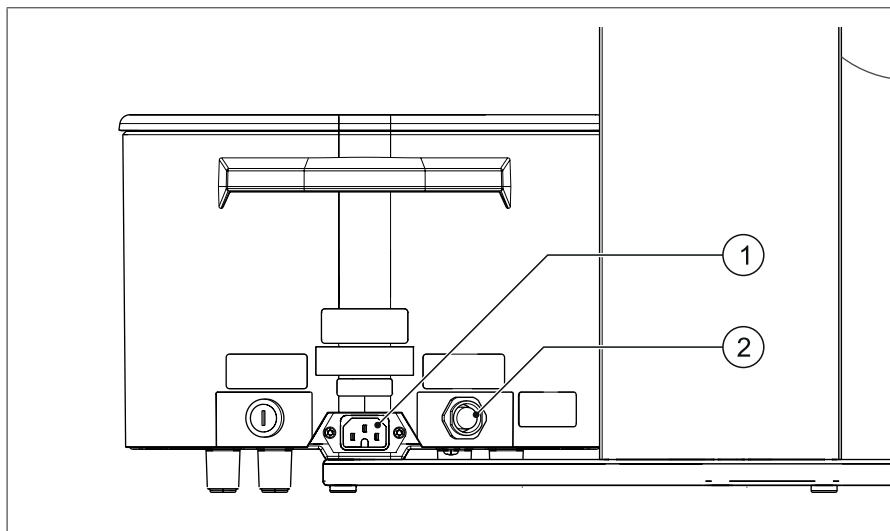
5.5 Connecting the vacuum and cooling media tubing

To achieve optimum distillation, all devices in the system should be matched to one another. Therefore, we recommend that the Rotavapor® R-100 is used together with the BUCHI Vacuum Pump V-100 and the BUCHI Recirculating Chiller F-100 or F-105 (see Chapter 3.2.4 "Typical application", page 14).



- ▶ Connect cooling media tubes to the two coolant connections (2) and (3) using GL14 cap nuts. There is no need to distinguish between flow and return when doing so.
- ▶ Connect the vacuum tubing to the vacuum connection (1) using a GL14 cap nuts.

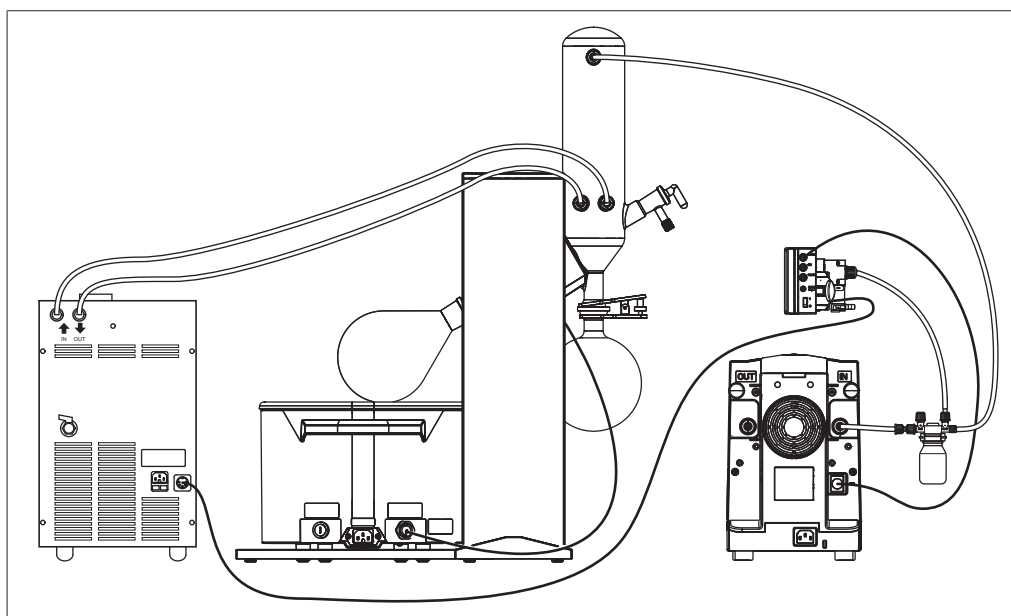
5.6 Electrical connections



- ▶ Make sure that the available power supply matches the rating indicated on the type plate.
- ▶ Plug the rotary drive unit connecting lead into the socket (2) on the heating bath.
- ▶ Plug the power cord into the socket (1) on the heating bath and then into a mains power socket.
- ▶ If an extension lead is required, make sure that it is earthed and has a suitable power rating.

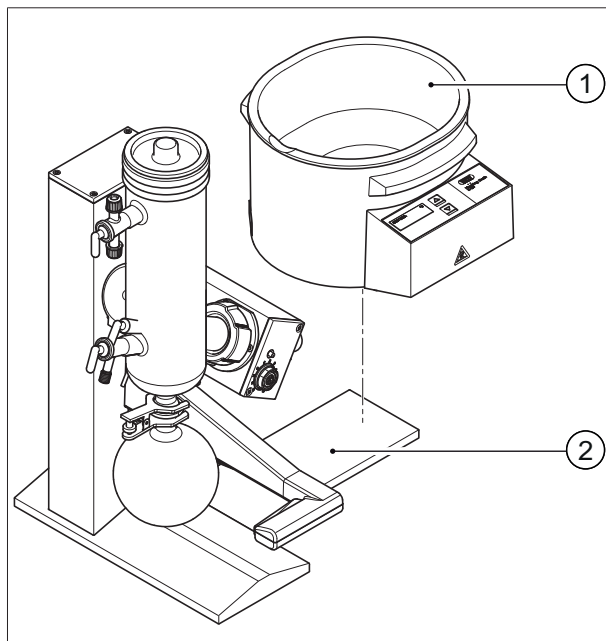
5.7 Overview of connections

The diagram below shows the connection of tubing and electrical leads in a typical application of the Rotavapor® R-100 in conjunction with a Recirculating Chiller F-105, a Vacuum Pump V-100, an Interface I-100 and a Woulff bottle (see also Chapter 3.2.4 "Typical application", page 14).



The connections to the Recirculating Chiller F-105, the Vacuum Pump V-100 and the Interface I-100 are described in the particular operating instructions in each case.

5.8 Setting up and filling the heating bath



- Locate the heating bath (1) in the L-shaped cut-out in the Rotavapor base (2).

IMPORTANT

Risk of heating bath corrosion due to use of unsuitable heating fluid

- Do not use pure distilled water or de-ionised water.
- If pure distilled or de-ionised water has to be used, add 1 to 2 g of Borax ($\text{Na}_2\text{B}_4\text{O}_7 \times 10 \text{ H}_2\text{O}$) per litre of water.

The recommended fluid for use in the heating bath is water. Normal tap water may be mixed with distilled water with a mixing ratio of up to 1:1 according to the water hardness.

- Fill the heating bath with suitable fluid.

5.9 Quick check

- To complete the installation process, check the following points:
- Switch on the rotary drive unit, change the rotation speed and check that the evaporating flask rotates at a different speed.
- **CAUTION! Risk of skin burns.** Make sure that the heating bath is filled, switch on the heating bath and check that the heating fluid heats up (Chapter 6.1.1 "Preparing the heating bath", page 27).
- Check that the height of the rotary drive unit can be adjusted (see Chapter 6.1.5 "Vertical adjustment", page 30).

6 Operation

6.1 Preparations

6.1.1 Preparing the heating bath

CAUTION

Risk of skin burns from hot fluids and surfaces

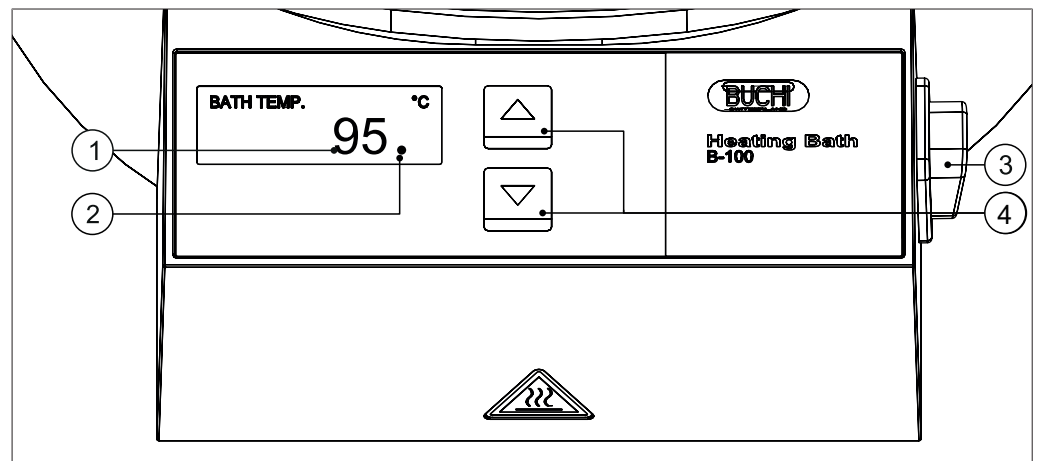
- ▶ Do not put your hands in the hot fluid.
- ▶ Do not carry, shift, tip or otherwise move the heating bath when it is filled with hot fluid.
- ▶ Do not fill the heating bath right to the very top. Allow for the expansion of the fluid when heated.
- ▶ Do not switch on the heating bath when it is empty.

CAUTION

Using oil as a heating fluid

Risk of skin burns from oil splashes

- ▶ Never pour water into hot oil.
- ▶ Make sure that the oil used is suitable for these purposes.



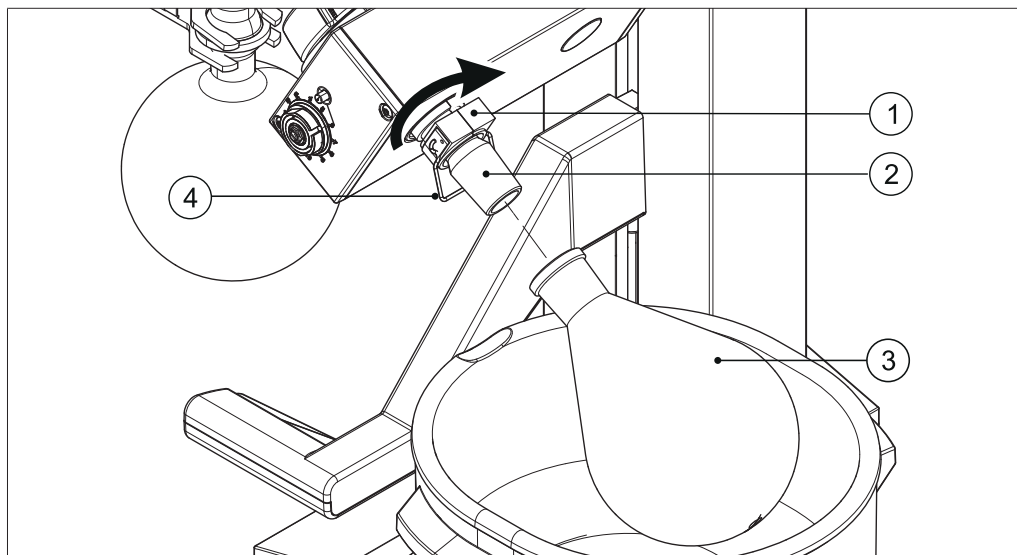
- ▶ Make sure that the heating bath is filled.
- ▶ Switch on the device at the master switch (3).
The heating bath temperature last set is displayed.
- ▶ Set the desired temperature using the adjustment buttons (4).
The set temperature (1) flashes during adjustment. Afterwards, the current actual temperature is indicated and the heater switched on.

6.1.2 Fitting the evaporating flask

IMPORTANT

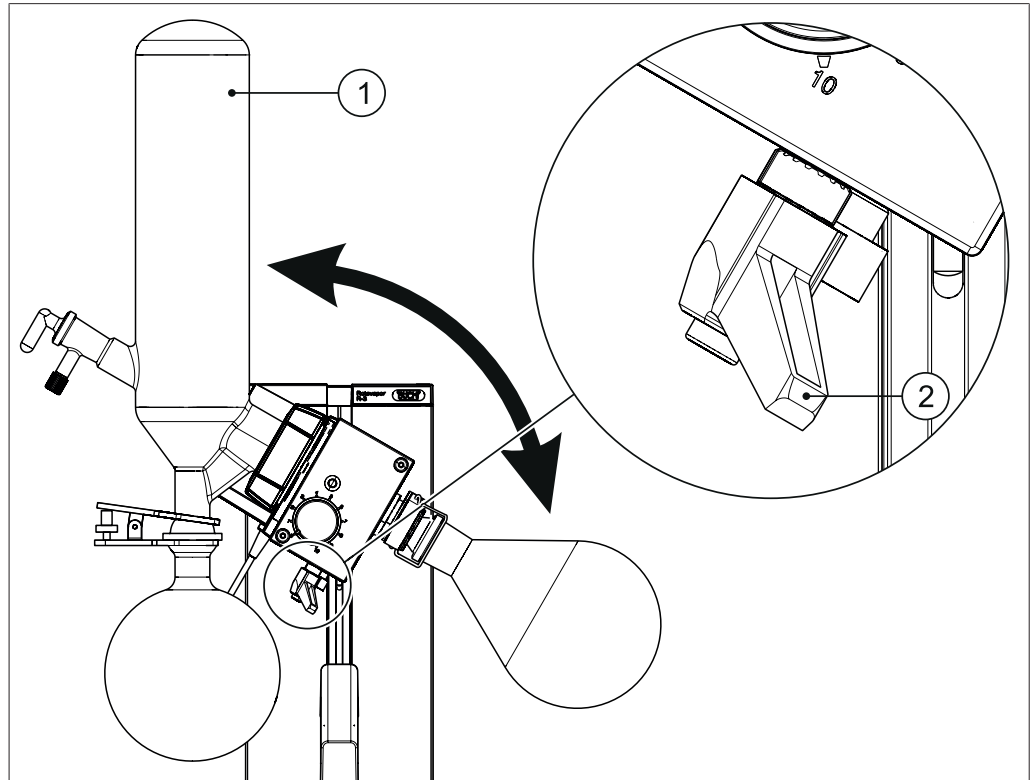
Risk of evaporating flask damage if fitted incorrectly

- ▶ When fitting the evaporating flask make sure that the edge of the glass does not strike the vapor duct.
- ▶ Tighten combi-clip no more than hand-tight.



- ▶ Carefully fit evaporating flask (3) onto the vapor duct (2).
- ▶ Slide clip (4) over the neck of the flask.
- ▶ Screw combi-clip (1) clockwise until hand-tight.

6.1.3 Adjusting immersion angle of evaporating flask

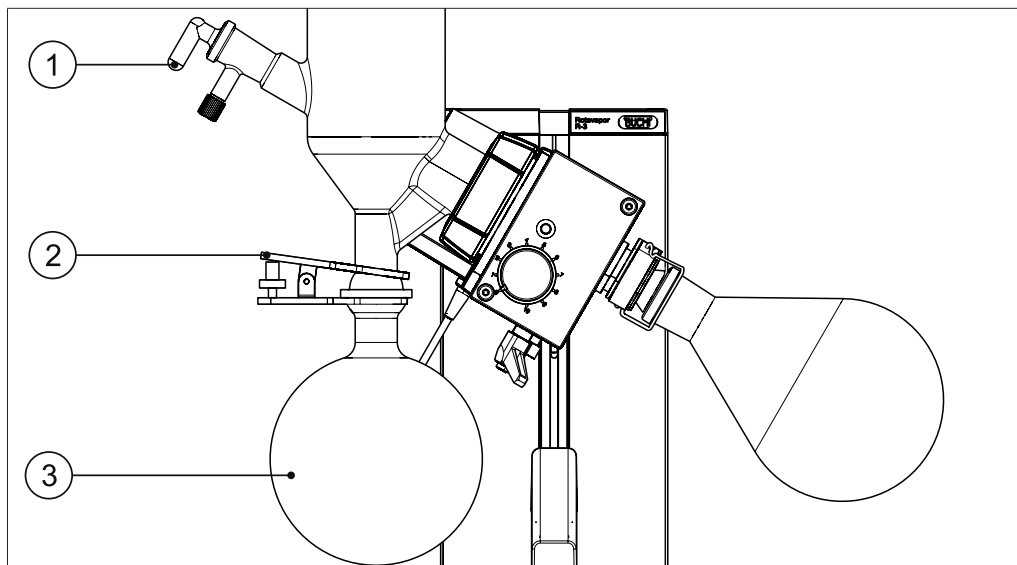


- ▶ Switch off the Rotavapor on the heating bath.
- ▶ Hold the condenser (1) firmly with one hand and release the lever (2) with the other hand.
- ▶ Adjust the immersion angle.
- ▶ Lock the rotary drive unit in position again with the lever (2).
- ▶ Make sure that there is at least 10 mm clearance between the edge of the heating bath and the evaporating flask or vapor duct. To achieve that, adjust the height of the rotary drive unit if necessary (see Chapter 6.2.1 "Raising and lowering the evaporating flask", page 33).
- ▶ Check the vertical end stop and adjust if necessary (see Chapter 6.1.5 "Vertical adjustment", page 30).

6.1.4 Fitting the receiving flask

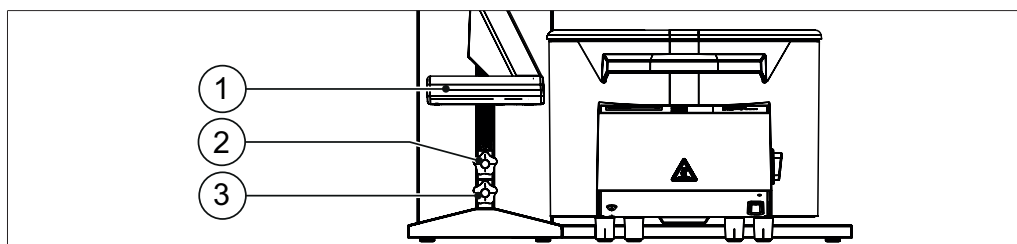
Materials required:

- Grease Glisseal 40 blue (order number 048197)



- Apply a thin coat of Grease Glisseal 40 blue to the ground joint of the receiving flask.
- Fit the receiving flask (3) onto the condenser from below and secure it with the ball joint clamp (2).

6.1.5 Vertical adjustment

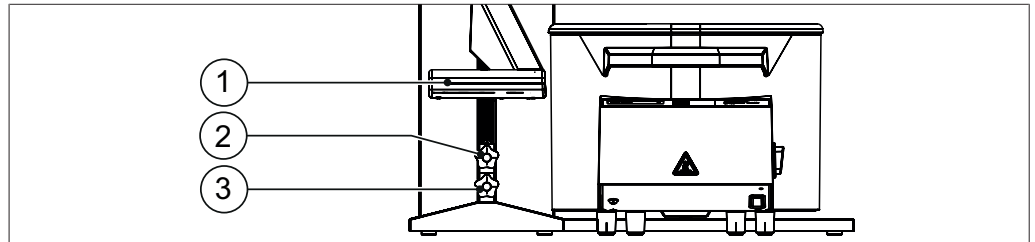


The rotary drive unit together with the glass components can be raised or lowered in the following ways:

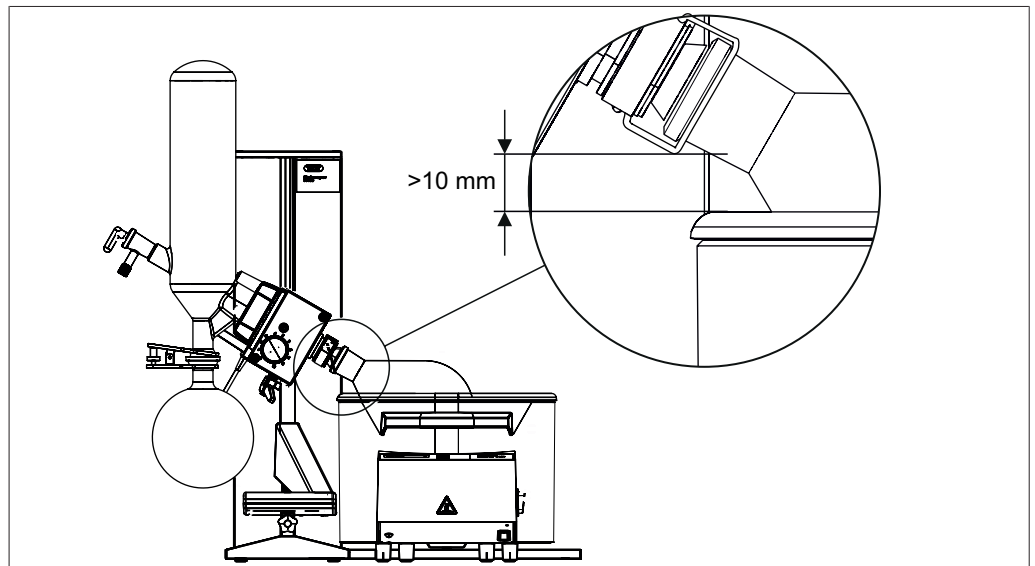
- Using the handle (1), the evaporating flask can be lowered into and lifted out of the heating bath (see Chapter 6.2.1 "Raising and lowering the evaporating flask", page-33). To prevent the evaporating flask and the vapor duct from colliding with the heating bath, a lower stop can be set using the screw-handle (2).
- If an especially large evaporating flask or a long vapor duct is being used, the entire vertical adjustment range can be moved up or down by means of screw-handle (3) (see Chapter "Moving the vertical adjustment range up/down", page 31).

Moving the vertical adjustment range up/down**CAUTION****Risk of injury when adjusting apparatus height**

- ▶ Make sure that your fingers are not trapped when adjusting the apparatus height.
- ▶ Make sure that all tubing are long enough and are not under strain after making the adjustment.



- ▶ Loosen the two screw-handles (2) and (3).
- ▶ Move the rotary drive unit together with the glass components and screw-handles so that the adjustment range of handle (1) is sufficient to be able to immerse the evaporating flask in the heating bath and completely lift it out of the heating bath.
- ▶ Tighten screw-handle (3).
- ▶ Adjust screw-handle (2) so that it acts as a stop for downward adjustment of handle (1). When the handle is at its lowest position, there should be a minimum clearance of 10 mm between the evaporating flask and the edge and/or the bottom of the heating bath in order to prevent the flask colliding with the heating bath.



- ▶ Tighten screw-handle (2).

6.2 Performing distillation



DANGER

Risk of poisoning from inhalation of hazardous vapors

- ▶ Do not inhale any vapors produced during distillation.
- ▶ Ensure that vapors are removed immediately by a suitable fume hood.
- ▶ Only use the device in well ventilated areas.
- ▶ If vapors escape from joints or connections, check the seals concerned and replace them if necessary.
- ▶ Do not distill any unknown fluids.
- ▶ Observe the safety data sheets for all fluids used.



DANGER

Explosion risk from distillation of hazardous materials

- ▶ Do not distill solvents that produce explosive mixtures of gases.
- ▶ Make sure that there is always a sluggishly reactive atmosphere inside the system.
- ▶ Discharge any electrostatic charge by suitable grounding arrangements.
- ▶ Keep sources of ignition away from the apparatus.



WARNING

Risk of explosion from excessive internal pressure

The evaporating flask and/or the condenser could explode if the internal pressure produced by evaporation becomes too great.

- ▶ Make sure that the internal pressure inside the glass components is never greater than atmospheric pressure.



CAUTION

Risk of skin burns from hot components

- ▶ Do not touch hot components unless wearing suitable protective gloves.

To achieve optimum distillation results, the following procedure is recommended:

- ▶ Adjust the flow rate of the coolant to suit the type of coolant and the cooling capacity. If tap water is used, the flow rate should be at least 40 L/h.
- ▶ Make sure that the coolant temperature is not more than 20 °C.
- ▶ Pour solvent into evaporating flask and fit evaporating flask (see Chapter 6.1.2 "Fitting the evaporating flask", page 28).
- ▶ Make sure that the receiving flask is fitted.
- ▶ Close the glass stopcock.
- ▶ Switch on the rotary drive unit and adjust the rotation speed if necessary.
- ▶ Set the vacuum so that the boiling point of the solvent is 20 °C below the temperature of the heating bath.

- ▶ Immerse the evaporating flask in the heating bath (see Chapter 6.2.1 "Raising and lowering the evaporating flask", page 33).
- ▶ Wait 1 – 2 minutes to make sure distillation starts.
- ▶ If necessary, adjust the vacuum and/or the heater temperature (see Chapter 6.2.3 "Optimization distillation", page 35).

6.2.1 Raising and lowering the evaporating flask

CAUTION

Risk of scalding if heating bath overflows

- ▶ When immersing the evaporating flask, make sure that the fluid does not overflow due to the displacement.
- ▶ When the evaporating flask is rotating look out for splashing fluid.



CAUTION

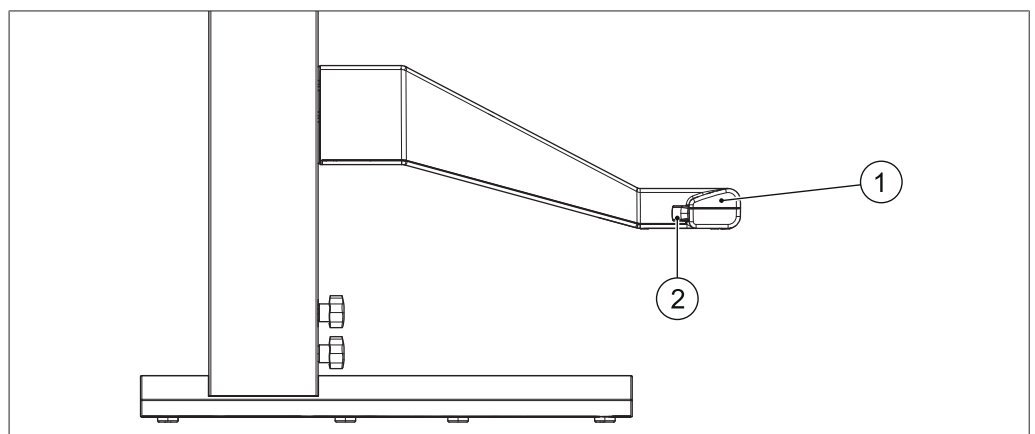
Risk of injury when adjusting apparatus height

- ▶ Make sure that your fingers are not trapped when adjusting the apparatus height.
- ▶ Make sure that all tubing are long enough and are not under strain after making the adjustment.

IMPORTANT

Risk of evaporating flask damage due to collision with edge of heating bath

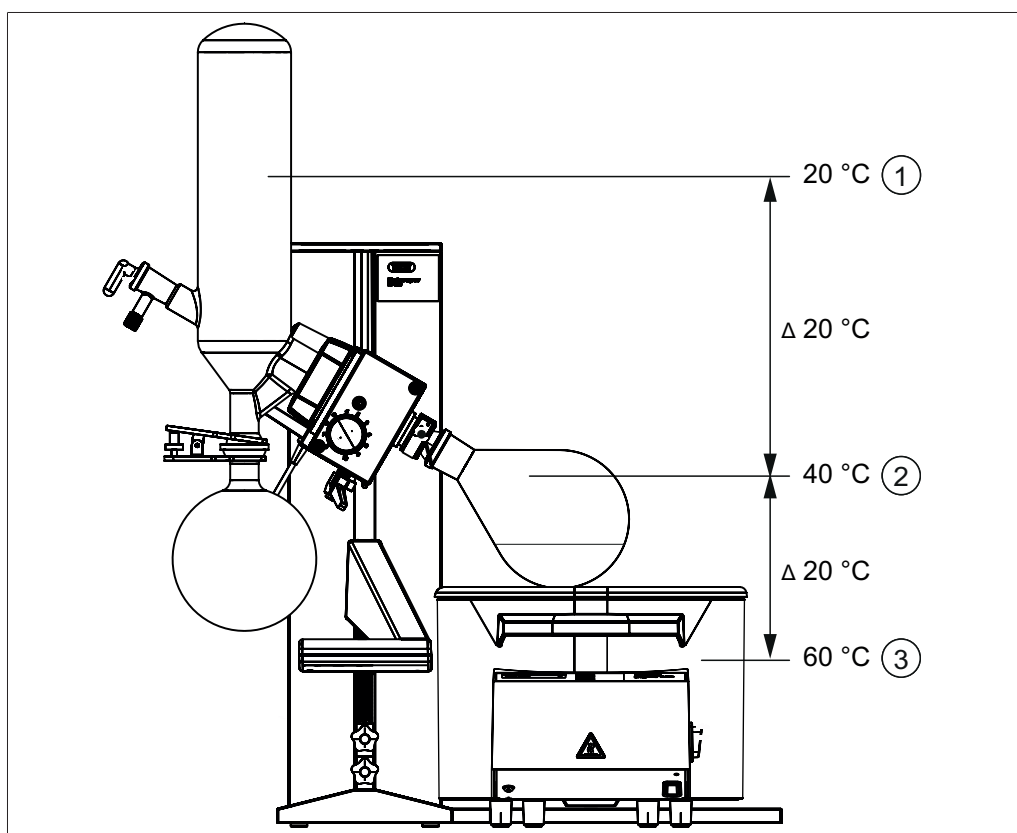
- ▶ Make sure that there is at least 10 mm clearance between the evaporating flask and the edge and/or bottom of the heating bath.



- ▶ Press and hold down the vertical adjustment handle release button (2).
- ▶ Move the rotary drive unit up or down by means of the vertical adjustment handle (1).
- ▶ Let go of the release button to lock the handle at the desired height.

6.2.2 Adjusting distillation conditions

To obtain optimum distillation conditions, the energy absorbed by the solvent from the heating bath must be removed again in the condenser. To achieve that, the following settings are recommended:



- 1 Coolant temperature: 20 °C
- 2 Vapor temperature: 40 °C
- 3 Heating bath temperature: 60 °C

The temperature difference between heating bath and evaporating flask and between evaporating flask and condenser should be 20 °C in each case.

The pressure in the evaporating flask should be set so that the boiling point of the solvent is around 40 °C (see Chapter 10.1 "Solvent table", page 47).

The flow rate of the coolant depends on the type of coolant used and the capacity of the cooler but should be at least 40 – 50 L/h.

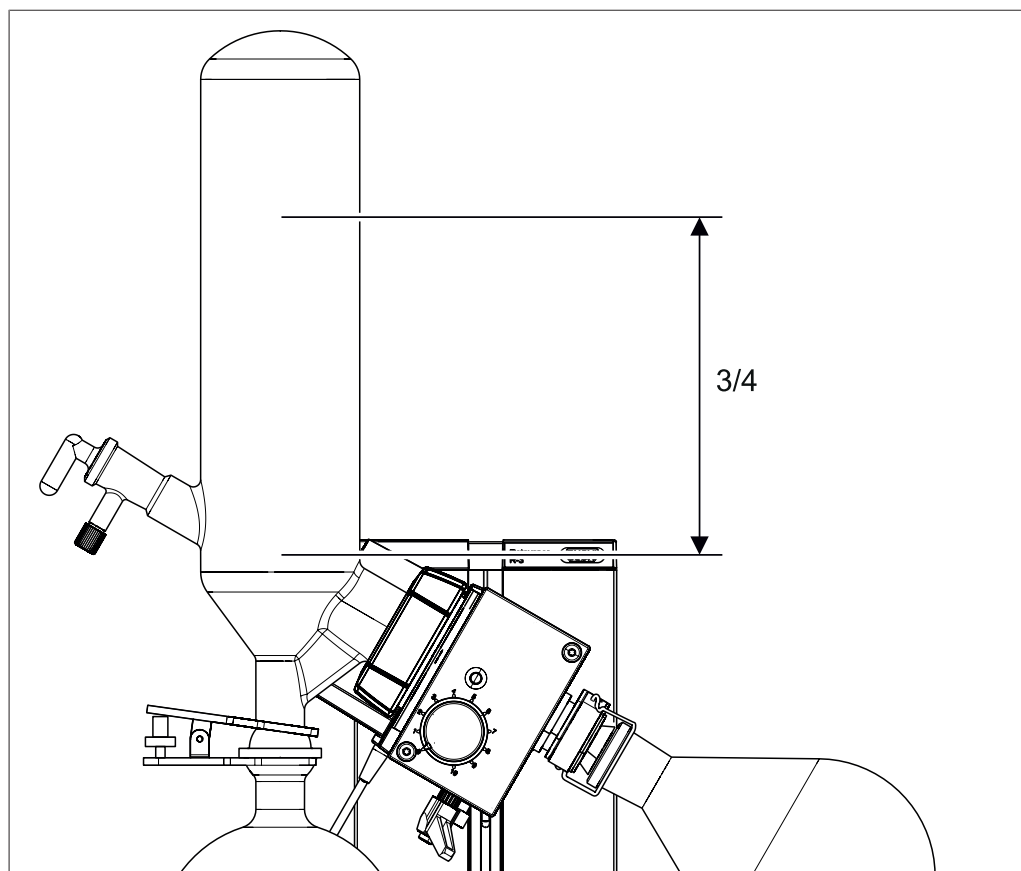
Those settings offer the following advantages:

- The evaporating flask can be replaced without the risk of skin burns.
- The evaporation rate of the water in the heating bath is low.
- The energy of the heating bath is efficiently utilized.

To achieve optimum distillation, all devices in the system should be matched to one another. Therefore, we recommend that the Rotavapor® R-100 is used together with the BUCHI Vacuum Pump V-100 and the BUCHI Recirculating Chiller F-105 (see Chapter 3.2.4 "Typical application", page 14). That will enable achievement of a stable vacuum and stable cooling, and thus a more efficient distillation process.

6.2.3 Optimization distillation

Depending on the solvent involved, it may also be possible to further optimize the distillation process. The distillation should always be set up so that the condensate does not cover more than three quarters of the coil in the condenser. The top quarter should remain exposed.



WARNING

Risk of explosion from excessive internal pressure

The evaporating flask and/or the condenser could explode if the internal pressure produced by evaporation becomes too great.

- ▶ Make sure that the internal pressure inside the glass components is never greater than atmospheric pressure.

If the condensation is below 3/4 of the condenser:

- ▶ increase the vacuum.
That will lower the boiling point and more vapor will enter the condenser.
- ▶ In applications where no vacuum is applied, raise the temperature of the heating bath if necessary.
That will cause more solvent to evaporate.

If the condensation is above 3/4 of the condenser:

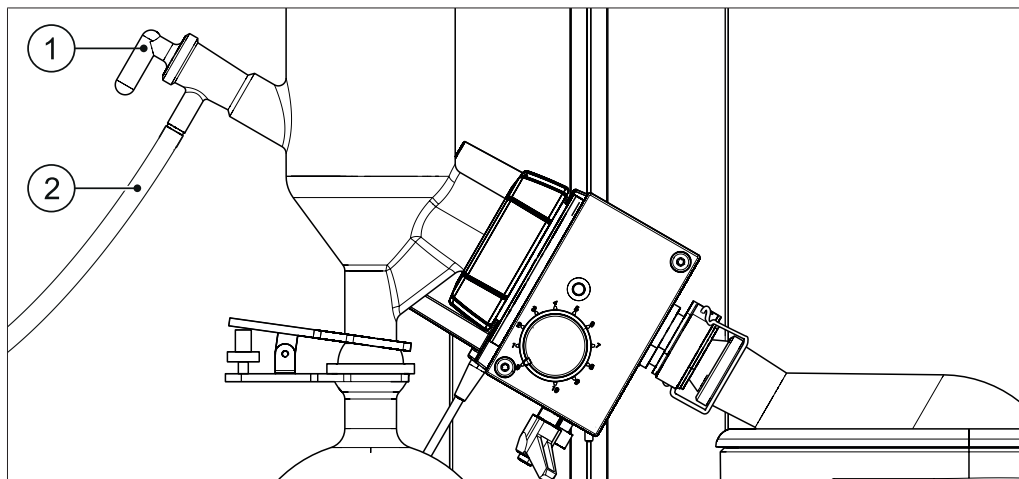
- ▶ decrease the vacuum.
That will raise the boiling point and less vapor will enter the condenser.

- ▶ In applications where no vacuum is applied, lower the temperature of the heating bath.
That will cause less solvent to evaporate.

6.2.4 Feeding solvent during distillation

Precondition:

- ☑ An external vacuum pump is connected and running.
- ☑ A feed tubing leading from the glass stopcock to the evaporating flask is fitted.

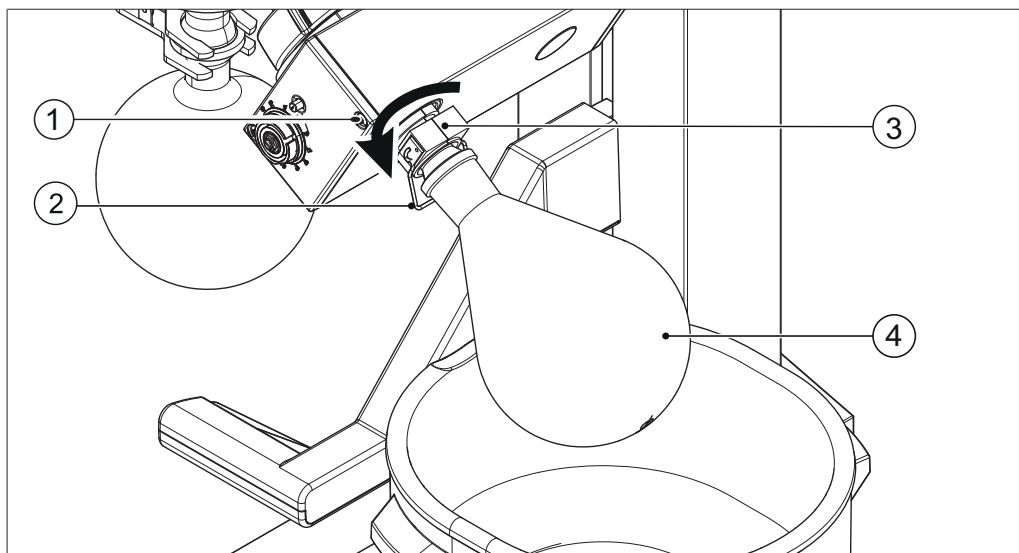


- ▶ Connect a supply tubing (2) for the solvent to the glass stopcock (1) and hold it in the solvent.
- ▶ Turn the glass stopcock until the handle is pointing downwards.
Solvent is drawn into the evaporating flask by the vacuum.
- ▶ Make sure that there is not more than 3 kg of solvent in the evaporating flask.
- ▶ Close the glass stopcock.

6.3 Finishing distillation

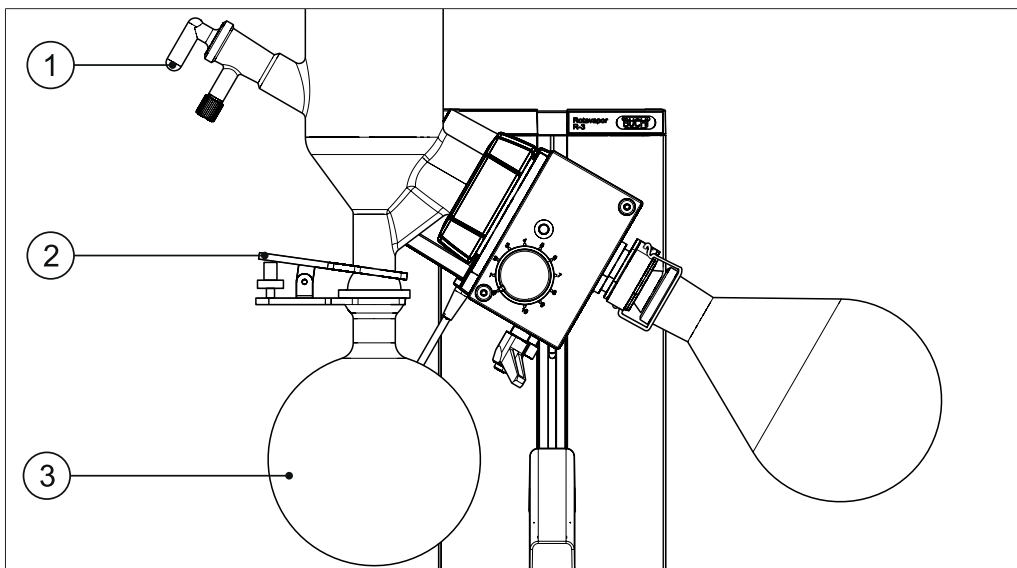
- ▶ Raise the rotary drive unit (see Chapter 6.2.1 "Raising and lowering the evaporating flask", page 33).
- ▶ Vent the Rotavapor.
- ▶ Turn off the rotary drive unit (set the rotation speed to 0 rpm).
- ▶ Switch off the heating bath
- ▶ **CAUTION! Risk of skin burns from hot evaporating flask.** Check the temperature of the evaporating flask and, if necessary, allow it to cool down or else wear suitable protective gloves.
- ▶ Remove the evaporating flask (see Chapter 6.3.1 "Removing the evaporating flask", page 37).
- ▶ Turn off the coolant supply.
- ▶ Remove the receiving flask (see Chapter 6.3.2 "Removing the receiving flask", page 38).
- ▶ Dry the Rotavapor (see Chapter 7.6 "Removing solvent accumulations", page 41).
- ▶ Clean the Rotavapor and all glass components (see Chapter 7 "Cleaning and servicing", page 39).

6.3.1 Removing the evaporating flask



- ▶ Raise the rotary drive unit (see Chapter 6.2.1 "Raising and lowering the evaporating flask", page 33).
- ▶ Vent the Rotavapor.
- ▶ Turn off the rotary drive unit (set the rotation speed to 0 rpm).
- ▶ **CAUTION! Risk of skin burns from hot evaporating flask.** Check the temperature of the evaporating flask and, if necessary, allow it to cool down or else wear suitable protective gloves.
- ▶ Firmly hold the evaporating flask (4) and release the combi-clip (3) by screwing it counter-clockwise.
- ▶ Push the clip (2) back from the neck of the evaporating flask.
- ▶ Detach the evaporating flask.
- ▶ If the evaporating flask sticks because of chemical residues, press the lock release button (1) and twist the flask (4) counter-clockwise to remove it.

6.3.2 Removing the receiving flask



- ▶ Raise the rotary drive unit (see Chapter 6.2.1 "Raising and lowering the evaporating flask", page 33).
- ▶ Vent the Rotavapor.
- ▶ Turn off the rotary drive unit (set the rotation speed to 0 rpm).
- ▶ Firmly hold the receiving flask (3), remove the ball joint clamp (2) and remove the receiving flask.
- ▶ Make sure that any dripping condensate cannot cause any damage.

7 Cleaning and servicing



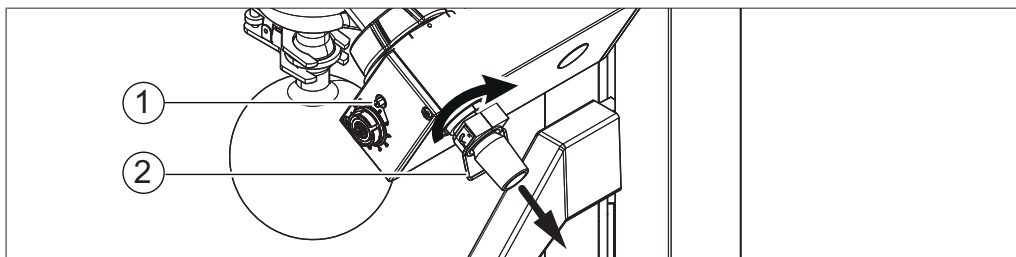
NOTE

Users may only carry out the servicing and cleaning operations described in this section.

Any servicing and repair work which involves opening up the housing may only be carried out by BÜCHI service technicians.

- ▶ Use only genuine BÜCHI consumables and spare parts in order to ensure correct operation of the device and preserve the warranty.
- ▶ .

7.1 Inspecting and cleaning the vapor duct



- ▶ Switch off the device.
- ▶ Remove the evaporating flask (see Chapter 6.3.1 "Removing the evaporating flask", page 37).
- ▶ Press the lock release button (1) on the front of the rotary drive unit.
- ▶ Firmly hold the vapor duct and turn the combi-clip (2) clockwise until the vapor duct is released.
- ▶ Visually inspect the vapor duct for damage, wear marks and residues.
- ▶ Clean the vapor duct with a paper towel and water or ethanol.
- ▶ Refit the vapor duct (see Chapter 5.3 "Fitting the vapor duct and condenser", page 22).

7.2 Checking the system for leaks

Precondition:

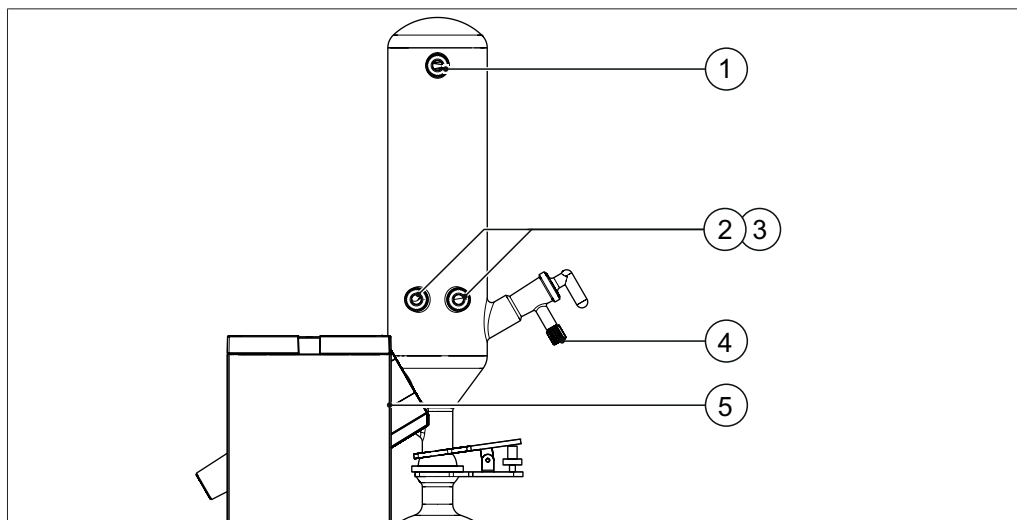
- ☒ An external vacuum pump with a pressure gauge is connected.
- ▶ Make sure that all flasks are fitted and the glass stopcock is closed.
- ▶ Connect the vacuum pump and evacuate the R-100 to a pressure of 50 mbar.
- ▶ Switch off the vacuum pump. If necessary, disconnect the vacuum tubing so as to exclude the vacuum pump as a possible source of a leak.
- ▶ Check the pressure after one minute.
- ☐ If the pressure has risen by less than 3 mbar after one minute, the system is air-tight.

If the system is not air-tight:

- ▶ Check all seals (see Chapter 7.3 "Checking seals", page 40).
- ▶ Examine all tubing and replace if they are brittle or cracked.
- ▶ Grease ground glass joints if necessary.

7.3 Checking seals

Seals are wear parts. They have to be regularly inspected, cleaned and, if necessary, replaced. The life of a seal depends on much it is used and how well it is looked after.



- | | |
|--------------------------|-------------------------------|
| 1 Vacuum connection seal | 4 Feed tubing seal |
| 2 Coolant seal | 5 Vacuum gasket (not visible) |
| 3 Coolant seal | |

- ▶ Remove seals and inspect for damage and cracks.
- ▶ Rinse intact seals in water or ethanol and dry with a soft cloth.
- ▶ Replace damaged seals and check the corresponding glass contact faces for damage (e.g. wear marks).



NOTE

New PTFE seals require approx. 10 hours to achieve an optimum seal.

7.4 Cleaning the condenser

- ▶ Using a wash bottle, squirt ethanol into the vacuum connection of the condenser and rinse it out.
- ▶ After rinsing allow the ethanol to drain out at the bottom.
- ▶ Use an alkaline cleaning agent to remove stubborn dirt (e.g. algae).

7.5 Cleaning the heating bath

IMPORTANT

Risk of short circuit from fluid penetration into device

- ▶ Do not immerse heating bath or rotary drive unit in water or pour water over them.
- ▶ Only wipe down the housing with a damp cloth.

The inside of the heating bath bowl should be cleaned regularly and at the latest if:

- the heating bath is contaminated
 - limescale deposits start to form
 - the stainless steel surface of the heating bath starts to rust
- ▶ Unplug the power supply for the heating bath and rotary drive unit.
 - ▶ Allow the heating bath to cool down then empty it.
 - ▶ Remove small amounts of limescale in the bowl of the heating bath using non-abrasive cleaners (e.g. household cleaner and washing-up sponge).
 - ▶ Use acetic acid to dissolve stubborn limescale deposits. Afterwards thoroughly rinse out the bath.

7.6 Removing solvent accumulations

Before any extended period in which the device is not used (e.g. overnight) all fluids must be removed from the device and the system dried.

- ▶ Fit a clean and dry evaporating flask and receiving flask (see Chapter 6.1.2 "Fitting the evaporating flask", page 28 and Chapter 6.1.4 "Fitting the receiving flask", page 30).
- ▶ Make sure that the glass stopcock is closed.
- ▶ Connect the vacuum pump and evacuate the R-100 as much as possible.
- ▶ Allow the vacuum pump to run for a further 2 to 3 minutes.
- ▶ Vent the Rotavapor.
- ▶ Check that all solvent accumulations have been removed.
- ▶ Dispose of solvent residues in accordance with the specifications of the applicable safety data sheet.

8 Help with faults

8.1 Faults, possible causes and remedies

Fault	Possible cause	Remedy
Device does not work	Device is not connected to power supply	▶ Check power supply (see Chapter 5.6 "Electrical connections", page 25).
	Fuse blown	▶ Replace fuse (see Chapter 8.2.2 "Replacing the fuse", page 45). ▶ If fault recurs, contact BUCHI Customer Service.
Heating bath fails to heat up	Device is not connected to power supply	▶ Check power supply (see Chapter 5.6 "Electrical connections", page 25).
	High temperature cut-out has tripped	▶ Reset the overheat safety cut-out (see Chapter 8.2.1 "Resetting overheat safety cut-out", page 44).
	Fuse blown	▶ Replace fuse (see Chapter 8.2.2 "Replacing the fuse", page 45). ▶ If fault recurs, contact BUCHI Customer Service.
System leaking	Ground glass joints not greased	▶ Grease ground glass joints.
	Tubing leaking	▶ Replace tubing (see Chapter 5.5 "Connecting the vacuum and cooling media tubing", page 24).
	Seal defective	▶ Replace seal (see Chapter 7.3 "Checking seals", page 40).
Vacuum is not achieved	Back-evaporation from the receiving flask	▶ Empty the receiving flask (see Chapter 6.3.2 "Removing the receiving flask", page 38).
	Temperature difference between evaporating flask and condenser less than 20 °C	▶ Increase cooling (see Chapter 6.2.2 "Adjusting distillation conditions", page 34).
	System leaking	▶ Check system for leaks (see Chapter 7.2 "Checking the system for leaks", page 39).
	Water pressure of glass filter pump too low	▶ Increase water flow (see pump operating instructions).
	Vacuum pump too weak	▶ Use suitably dimensioned vacuum pump.

Fault	Possible cause	Remedy
Optimum distillation not achieved	Too much back-evaporation from the receiving flask (especially with solvent mixtures)	<ul style="list-style-type: none"> ▶ Empty receiving flask and restart distillation (see Chapter 6.3.2 "Removing the receiving flask", page 38, Chapter 6.1.4 "Fitting the receiving flask", page 30 and Chapter 6.2 "Performing distillation", page 32).
	Other faults in distillation process (e.g. sudden cooling, too little heat flow, etc.)	<ul style="list-style-type: none"> ▶ Check temperatures of heating bath and coolant and adjust as necessary (see Chapter 6.1.1 "Preparing the heating bath", page 27 and/or cooler operating instructions). ▶ Lower pressure until distillation resumes (see vacuum pump operating instructions).

8.2 Remedy

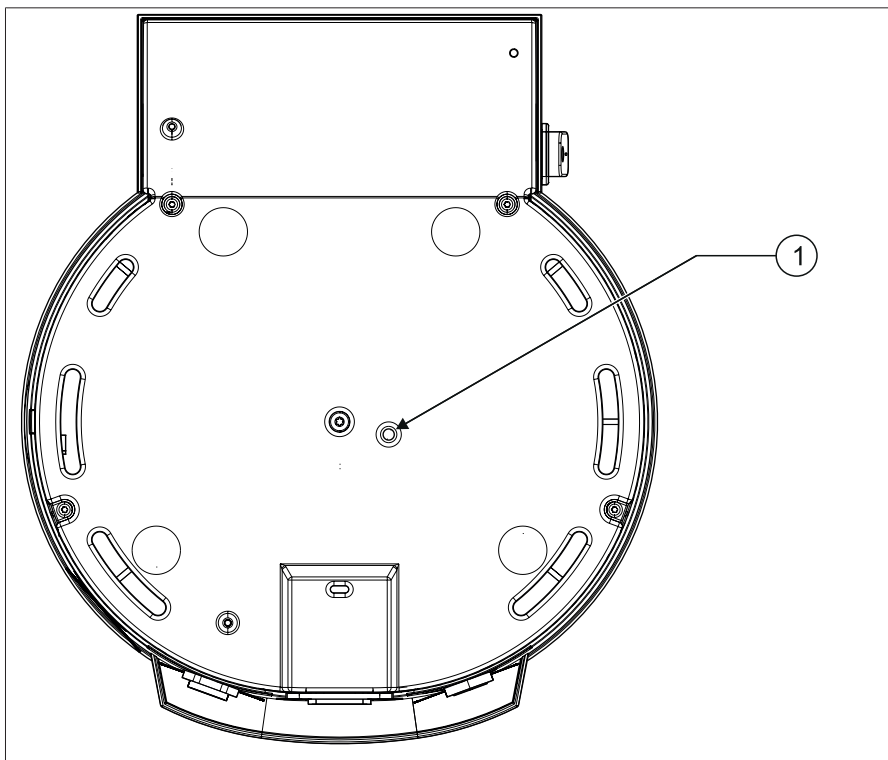
8.2.1 Resetting overheat safety cut-out



CAUTION

Risk of skin burns from hot components

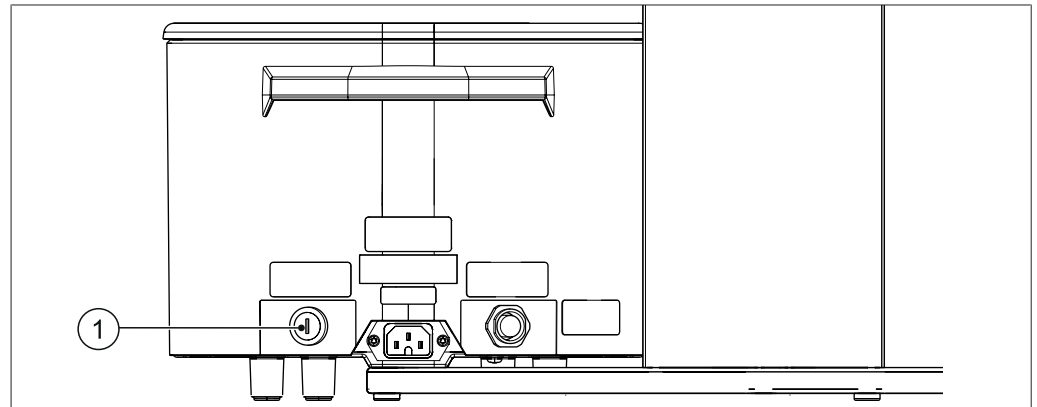
- Do not touch hot components unless wearing suitable protective gloves.



- Switch off the device.
 - Unplug the power supply for the heating bath and rotary drive unit.
 - Allow the heating bath to cool down then empty it.
 - Using a narrow object or screwdriver, press the switch (1) on the underside of the heating bath.
- ☐ The overheat safety cut-out is reset.

8.2.2 Replacing the fuse

The fuse is on the rear of the heating bath.



- ▶ Allow the heating bath to cool down.
- ▶ Disconnect the power cord.
- ▶ Open the fuse holder (1) with a large screwdriver.
- ▶ Replace the blown fuse with an intact one of the same rating.
- ▶ Screw the fuse holder (1) back in.
- ▶ Reconnect the power cord.

9 Taking out of service and disposal

9.1 Taking out of service

- ▶ Remove all fluids from the glass components (see Chapter 7.6 "Removing solvent accumulations", page 41).
- ▶ Switch off the device.
- ▶ Unplug the power supply for the heating bath and rotary drive unit.
- ▶ Remove all glass components.

9.2 Disposal

The operator is responsible for proper disposal of the Rotavapor®.

- ▶ When disposing of equipment observe the local regulations and statutory requirements regarding waste disposal.

10 Appendix

10.1 Solvent table

Solvent	Formula	Molar mass in g/mol	Evaporation energy in J/g	Boiling point in °C at 1013 mbar	Density in g/cm ³	Vacuum in mbar for 40-°C boiling point
Acetone	CH ₃ H ₆ O	58.1	553	56	0.790	556
<i>n</i> -Amyl alcohol, <i>n</i> -pentanol	C ₅ H ₁₂ O	88.1	595	37	0.814	11
Benzene	C ₆ H ₆	78.1	548	80	0.877	236
<i>n</i> -butanol	C ₄ H ₁₀ O	74.1	620	118	0.810	25
Tert butyl alcohol (2-methyl-2-propanol)	C ₄ H ₁₀ O	74.1	590	82	0.789	130
Chlorobenzene	C ₆ H ₅ Cl	112.6	377	132	1.106	36
Chloroform	CHCl ₃	119.4	264	62	1.483	474
Cyclohexane	C ₆ H ₁₂	84.0	389	81	0.779	235
Diethyl ether	C ₄ H ₁₀ O	74.0	389	35	0.714	850
1,2-dichloroethane	C ₂ H ₄ Cl ₂	99.0	335	84	1.235	210
<i>cis</i> -1,2-dichloroethylene	C ₂ H ₂ Cl ₂	97.0	322	60	1.284	479
<i>trans</i> -1,2-dichloroethylene	C ₂ H ₂ Cl ₂	97.0	314	48	1.257	751
Di-isopropyl ether	C ₆ H ₁₄ O	102.0	318	68	0.724	375
Dioxane	C ₄ H ₈ O ₂	88.1	406	101	1.034	107
DMF (dimethylformamide)	C ₃ H ₇ NO	73.1	–	153	0.949	11
Acetic acid	C ₂ H ₄ O ₂	60.0	695	118	1.049	44
Ethanol	C ₂ H ₆ O	46.0	879	79	0.789	175
Ethylacetate	C ₄ H ₈ O ₂	88.1	394	77	0.900	240
Heptane	C ₇ H ₁₆	100.2	373	98	0.684	120
Hexane	C ₆ H ₁₄	86.2	368	69	0.660	360
Isopropylalcohol	C ₃ H ₈ O	60.1	699	82	0.786	137
Isoamylalcohol (3-methyl-1-butanol)	C ₅ H ₁₂ O	88.1	595	129	0.809	14
Methylethylketone	C ₄ H ₈ O	72.1	473	80	0.805	243
Methanol	CH ₄ O	32.0	1227	65	0.791	337
Methylene chloride, dichloromethane	CH ₂ Cl ₂	84.9	373	40	1.327	850
Pentane	C ₅ H ₁₂	72.1	381	36	0.626	850
<i>n</i> -propylalcohol	C ₃ H ₈ O	60.1	787	97	0.804	67
Pentachloroethane	C ₂ HCl ₅	202.3	201	162	1.680	13

Solvent	Formula	Molar mass in g/mol	Evaporation energy in J/g	Boiling point in °C at 1013 mbar	Density in g/cm ³	Vacuum in mbar for 40-°C boiling point
1,1,2,2-tetrachloroethane	C ₂ H ₂ Cl ₄	167.9	247	146	1.595	20
Carbon tetrachloride	CCl ₄	153.8	226	77	1.594	271
1,1,1-trichloroethane	C ₂ H ₃ Cl ₃	133.4	251	74	1.339	300
Tetrachloroethylene	C ₂ Cl ₄	165.8	234	121	1.623	53
THF (tetrahydrofuran)	C ₄ H ₈ O	72.1	–	67	0.889	374
Toluene	C ₇ H ₈	92.2	427	111	0.867	77
Trichloroethylene	C ₂ HCl ₃	131.3	264	87	1.464	183
Water	H ₂ O	18.0	2261	100	1.000	72
Xylene (mixture)	C ₈ H ₁₀	106.2	389	–	–	25
<i>o</i> -xylene	C ₈ H ₁₀	106.2	–	144	0.880	–
<i>m</i> -xylene	C ₈ H ₁₀	106.2	–	139	0.864	–
<i>p</i> -xylene	C ₈ H ₁₀	106.2	–	138	0.861	–

10.2 Spare parts and accessories

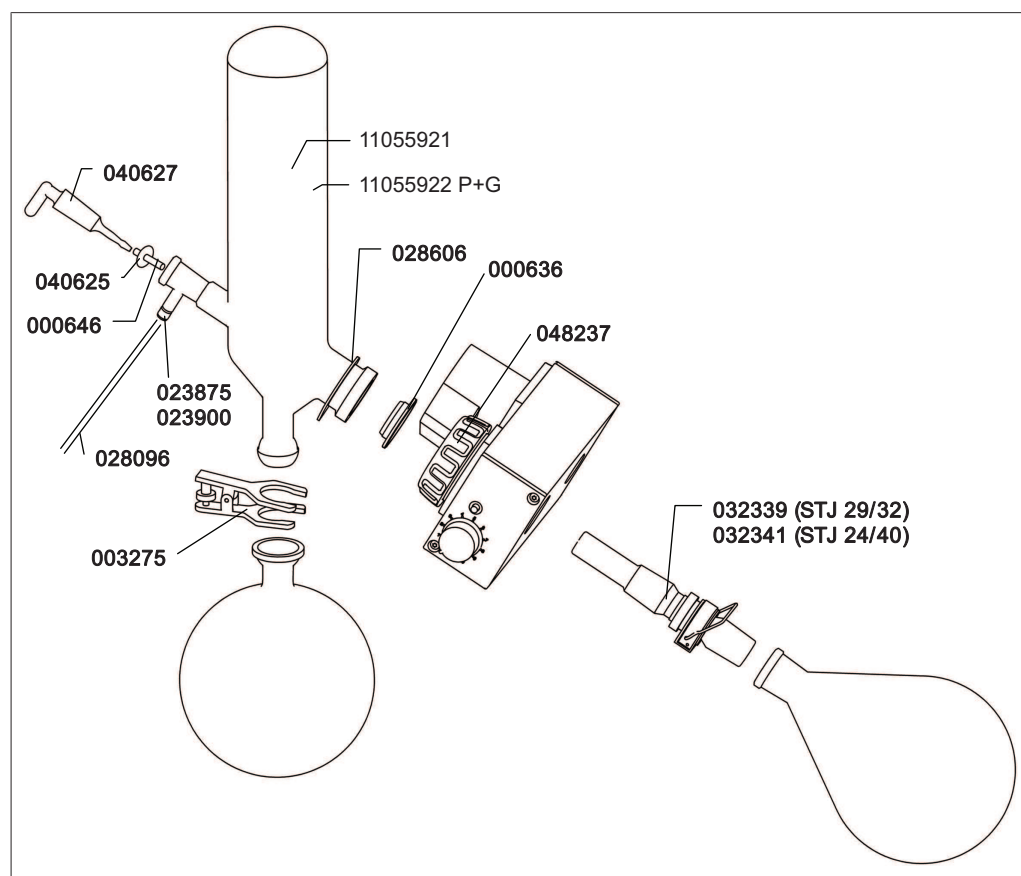
- Use only genuine BUCHI consumables and spare parts in order to ensure correct, safe and reliable operation of the system.



NOTE

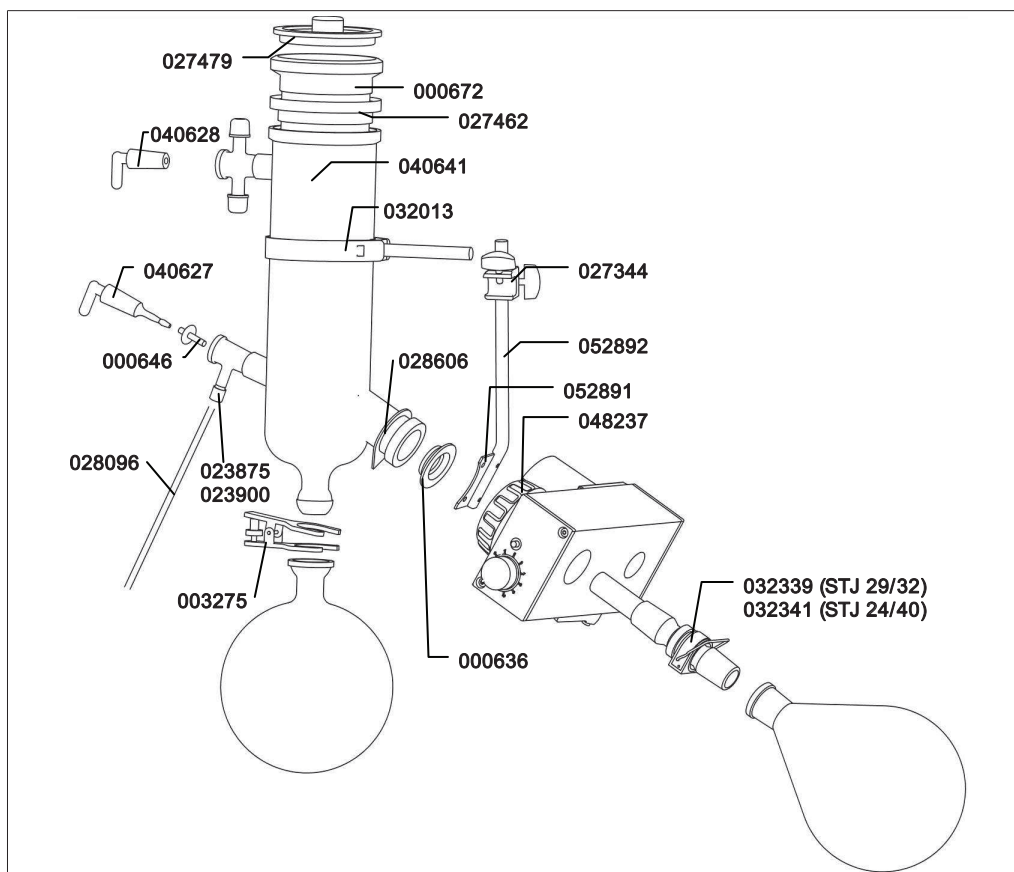
Any modifications of spare parts or assemblies are only allowed with the prior written permission of BUCHI.

10.2.1 Glass apparatus V



Order no.	Description	Order no.	Description
11057056	Glass assembly V. Vertical condenser, 1460cm ²	000646	Tubing. PTFE, Ø4.7/5.5mm, transparent, 330mm
11055921	Condenser V. Vertical cond., 1460cm ²	000636	Vacuum gasket. KD22, PTFE
11057057	Glass condenser V. Vertical cond., 1460cm ² , P+G	028096	Tubing. PTFE, Ø3/4mm, white, 600mm
038000	Hose barbs, set. 6 pcs., bent (4), straight (2), GL14, silicone seal	040625	Drain disc. PTFE, Ø5.1/14mm
032341	Vapor duct. For V/C cond., Ø22mm, SJ24/40, incl. combi-clip	003275	Ball joint clamp. For BJ35/20
032339	Vapor duct. For V/C cond, Ø22mm, SJ29/32, incl. combi-clip	040627	Glass stopcock. Standard, glass, SJ18.8/38
023875	Screw-cap. GL10	037642	Hose barbs, set. 4 pcs., straight, GL14, silicone seal
023900	O-ring. FPM, Ø3.0/2.7mm	037287	Hose barbs, set. 4 pcs., bent, GL14, silicone seal, incl. cap nut

10.2.2 Glass apparatus C



Order no.	Description	Order no.	Description
040640	Glass assembly C. Cold trap, 500cm ²	040627	Glass stopcock. Standard, glass, SJ18.8/38
040641	Cold trap mantle. For C condenser	038000	Hose barbs, set. 6 pcs., bent (4), straight (2), GL14, silicone seal
040645	Condenser C. Cold trap, 500cm ²	003275	Ball joint clamp. For BJ35/20
000672	Cold finger. For C condenser	023875	Screw-cap. GL10
027479	Lid. For C condenser, PETP	023900	O-ring. FPM, Ø3.0/2.7mm
027462	Seal, set. For C/CR condenser, PTFE, EPDM	037287	Hose barbs, set. 4 pcs., bent, incl. cap nut, GL14
037642	Hose barbs, set. 4 pcs., straight, GL14, silicone seal	052893	Condenser holder. For V/C condenser incl. rubber band
032341	Vapor duct. For V/C condenser, Ø22mm, SJ24/40, incl. combi-clip	032013	Rubber band. To fasten condenser
032339	Vapor duct. For V/C condenser, Ø22mm, SJ29/32, incl. combi-clip	027344	Cross sleeve. To fasten condenser
040628	Glass stopcock. For C condenser, glass	000636	Vacuum gasket. KD22, PTFE
000646	Tubing. PTFE, Ø4.7/5.5mm, transparent, 330mm	028096	Tubing. PTFE, Ø3/4mm, white, 600mm

10.2.3 Accessories

Heating Bath

Heating Bath B-100. 20-95°C, 220-240V	11061895
--	----------

Heating power: 1300 W, maximum flask size: 4000 mL Allows adjusting set temperature and indicates actual temperature digitally

Heating Bath B-100. 20-95°C, 100-120V	11061894
--	----------

Heating power: 1300 W, maximum flask size: 4000 mL Allows adjusting set temperature and indicates actual temperature digitally

Accessories for heating bath

Top cover. For Heating Bath B-491, B-100	048230
---	--------

To save energy and to minimize water evaporation when not in use

Protective shield. For Heating Bath B-491, B-100	048052
---	--------

Swimming balls. 450pcs, PP, Ø10mm	036405
--	--------

To reduce energy consumption of heating bath and for less evaporation of the heating medium, for temperatures up to 100 °C

Tubing

FEP, Ø6/8mm, transparent, per m	027900
--	--------

Utilization: Vacuum, cooling media

Natural rubber, Ø6/16mm, red, per m	017622
--	--------

Utilization: Vacuum

Nyflex, PVC-P, Ø8/14mm, transparent, per m	004113
---	--------

Utilization: Vacuum, cooling media

PTFE, Ø4.7/5.5mm, transparent, 330mm	000646
---	--------

To initiate solvent into the evaporating flask during distillation

PTFE, Ø8/10mm, white, per m	027277
------------------------------------	--------

Utilization: Vacuum, tubing (industrial Rotavapor)

Silicone rubber, Ø6/9mm, transparent, per m	004133
--	--------

Utilization: Cooling media

Further accessories

Flask holder. Ring, non-slippery EPDM	048618
--	--------

Holder for round-bottom flasks (50 – 5000 mL)

Flask holders, set. 5pcs, ring, non-slippery EPDM	11059916
--	----------

Holder for round-bottom flasks (50 – 5000 mL)

Cooling water valve. 24VAC	031356
-----------------------------------	--------

Valve opens cooling water feed during distillation, only used in combination with a vacuum controller/interface

Lab grease. Glisseal 40 (60g)	048197
--------------------------------------	--------

To grease the joints in order to increase tightness of the system

Manometer with needle valve. Incl. holder for pump, valve, vacuum gauge	047291
--	--------

For manual vacuum adjustment

Power adapter. 24VDC, voltage 100-240V, frequency 50/60Hz	11055312
--	----------

For operation of Rotavapor without heating bath

Water regulation nozzle. Restriction valve, hose clamp, sieve Used when tap water is applied as vacuum source, to reduce flow-rate of the water	011606
Water jet pump. Plastic Used when tap water is applied as the vacuum source	002913
Water jet pump, B-764. Magnetic valve, FFKM, 24V Simple principle of vacuum generation, without cooling water valve, only used in combination with a vacuum controller/interface	031358
Water jet pump, B-767. Magnetic valve (2pcs), FFKM, 24V Simple principle of vacuum generation, with cooling water valve, only used in combination with a vacuum controller/interface	031357

Glassware

Glass assemblies

Glass assembly C. Cold trap, 500cm² For the distillation of low-boiling point solvents. No need of cooling liquid. Contents: 1 L receiving flask, ball joint clamp, stopcock, feed tubing. Not included: Evaporating flask, vapor duct, holder	040640
Glass assembly C. Cold trap, 500cm², P+G For the distillation of low-boiling point solvents. No need of cooling liquid. Contents: 1 L receiving flask, ball joint clamp, stopcock, feed tubing. Not included: Evaporating flask, vapor duct, holder	040642
Glass assembly V. Vertical condenser, 1460cm² For standard application. Used with recirculating chiller or tap water. Features: No top hole. No connection for vapor temperature sensor. Contents: 1 L receiving flask, ball joint clamp, stopcock, feed tubing. Not included: Evaporating flask, vapor duct, holder	11057056
Glass assembly V. Vertical condenser, 1460cm², P+G For standard application. Used with recirculating chiller or tap water. Features: No top hole. No connection for vapor temperature sensor. Contents: 1 L receiving flask, ball joint clamp, stopcock, feed tubing. Not included: Evaporating flask, vapor duct, holder	11057057

Accessories for glass assemblies

Condenser holder. For V/C-condenser, incl. rubber band	052893
Foam trap adaptor	
Glass, Reitmeyer, SJ24/40, 150mm	036577
Glass, Reitmeyer, SJ29/32, 135mm	036576
Glass, bump trap, SJ24/40, 175mm	11056919
Glass, bump trap, SJ29/32, 160mm	11056920

Evaporating flask

For distillation spider, cylindric, SJ14/23, 20mL	000477
Glass, SJ24/40, 1000mL	000440
Glass, SJ24/40, 1000mL, P+G	020730
Glass, SJ24/40, 100mL	008751

Glass, SJ24/40, 2000mL	008765
Glass, SJ24/40, 2000mL, P+G	025262
Glass, SJ24/40, 250mL	008754
Glass, SJ24/40, 3000mL	008767
Glass, SJ24/40, 3000mL, P+G	025263
Glass, SJ24/40, 4000mL	047990
Glass, SJ24/40, 4000mL, P+G	047992
Glass, SJ24/40, 500mL	008758
Glass, SJ24/40, 500mL, P+G	025261
Glass, SJ24/40, 50mL	008750
Glass, SJ29/32, 1000mL	000435
Glass, SJ29/32, 1000mL, P+G	020729
Glass, SJ29/32, 100mL	000432
Glass, SJ29/32, 100mL, P+G	033404
Glass, SJ29/32, 2000mL	000436
Glass, SJ29/32, 2000mL, P+G	025323
Glass, SJ29/32, 250mL	000433
Glass, SJ29/32, 250mL, P+G	025520
Glass, SJ29/32, 3000mL	000437
Glass, SJ29/32, 3000mL, P+G	025324
Glass, SJ29/32, 4000mL	047991
Glass, SJ29/32, 4000mL, P+G	047993
Glass, SJ29/32, 500mL	000434
Glass, SJ29/32, 500mL, P+G	025322
Glass, SJ29/32, 50mL	000431
Glass, SJ29/32, 50mL, P+G	033405
Drying flask	
Glass, SJ24/40, 1000mL	000420
Glass, SJ24/40, 2000mL	011580
Glass, SJ24/40, 500mL	011579
Glass, SJ29/32, 1000mL	000453
Glass, SJ29/32, 2000mL	000454
Glass, SJ29/32, 500mL	000452
Beaker flasks	
Glass, SJ24/40, 1500mL, for drying	034270
Glass, SJ24/40, 1500mL, for evaporation	034247
Glass, SJ24/40, 500mL, for drying	034768
Glass, SJ24/40, 500mL, for evaporation	034765
Glass, SJ29/32, 1500mL, for drying	034269

Glass, SJ29/32, 1500mL, for evaporation	034230
Glass, SJ29/32, 500mL, for drying	034767
Glass, SJ29/32, 500mL, for evaporation	034764
Receiving flasks	
Glass, BJ35/20, 1000mL	000425
Glass, BJ35/20, 1000mL, P+G	020728
Glass, BJ35/20, 1000mL, P+G-LT Application temperature: -70 to 40 °C	040775
Glass, BJ35/20, 1000mL, P+G, drain valve	036919
Glass, BJ35/20, 100mL	000422
Glass, BJ35/20, 2000mL	000426
Glass, BJ35/20, 2000mL, P+G	025265
Glass, BJ35/20, 2000mL, P+G-LT Application temperature: -70 to 40 °C	040776
Glass, BJ35/20, 250mL	000423
Glass, BJ35/20, 250 mL, P+G	11060907
Glass, BJ35/20, 250 mL, P+G-LT Application temperature: -70 to 40 °C	11060908
Glass, BJ35/20, 3000mL	000427
Glass, BJ35/20, 3000mL, P+G	025266
Glass, BJ35/20, 3000mL, P+G-LT Application temperature: -70 to 40 °C	040777
Glass, BJ35/20, 500mL	000424
Glass, BJ35/20, 500mL, P+G	025264
Glass, BJ35/20, 500mL, P+G-LT Application temperature: -70 to 40 °C	040774
Glass, BJ35/20, 50mL	000421
Vapor ducts	
For V/C cond., Ø22mm, SJ24/40, incl. Combi-Clip	032341
For V/C cond., Ø22mm, SJ29/32, incl. Combi-Clip	032339
Stopcocks	
Stopcock. Professional, glass, SJ18.8/38 For aeration of the system. Less cross-contamination than with standard-stopcock	000637
Stopcock. PTFE, SJ18.8/38 For aeration of the system. For applications when grease should be avoided, used instead of standard-stopcock	023896
Stopcock. Standard, glass, SJ18.8/38 For aeration of the system	040627
Distillation spiders	
Glass, SJ24/40, incl. 100mL flask (5pcs)	011575

Glass, SJ24/40, incl. 20mL zyl. flask (20pcs)	011578
Glass, SJ24/40, incl. 50mL flask (5pcs)	011574
Glass, SJ29/32, incl. 100mL flask (5pcs)	001333
Glass, SJ29/32, incl. 20mL zyl. flask (12pcs)	001335
Glass, SJ29/32, incl. 20mL zyl. flask (20pcs)	001336
Glass, SJ29/32, incl. 20mL zyl. flask (6pcs)	001334
Glass, SJ29/32, incl. 50mL flask (5pcs)	001332

10.2.4 Wear parts

Vacuum gaskets

KD22, PTFE	000636
KD22, PTFE, FDA-compliant	11056622

Seals

For cap nut, GL14, FEP	038225
Set. 10pcs, for hose barbs, GL14, EPDM, black	040029
Set. 10pcs, for hose barbs, GL14, FPM, green	040040
Set. 20pcs, for hose barbs, GL14, silicone, red	040023

Hose barbs

Bent, GL14, incl. silicone seal	018916
Set. 2pcs, bent (1), straight (1), GL14, silicone seal Content: Hose barbs, cap nuts, seals	041939
Set. Set. 3pcs, bent, GL14, silicone seal Content: Hose barbs, seals	041987
Set. 4pcs, bent, GL14, EPDM seal Content: Hose barbs, cap nuts, seals	043129
Set. 4pcs, bent, GL14, FEP seal Content: Hose barbs, cap nuts, seals	040295
Set. 4pcs, bent, GL14, silicone seal, incl. cap nut Content: Hose barbs, cap nuts, seals	037287
Set. 4pcs, bent, GL14, silicone seal, incl. cap nut Content: Hose barbs, cap nuts, seals	043128
Set. 4pcs, straight, GL14, EPDM seal Content: Hose barbs, cap nuts, seals	040296
Set. 4pcs, straight, GL14, silicone seal Content: Hose barbs, cap nuts, seals	037642
Set. 6pcs, bent (4), straight (2), GL14, silicone seal Content: Hose barbs, cap nuts, seals	038000

Further wear parts

Screw caps, set. 5pcs, GL14	040624
Cap nuts, set. 10pcs, screw cap with hole, GL14, incl. FEP seal Content: Hose barbs, cap nuts, seals	041999

	Cap nuts, set. 10pcs, cap nuts with hole, GL14	041956
10.2.5	Spare parts	
	Drain disc. PTFE, Ø5.1/14mm	040625
	Top cover. For C condenser, PETP	027479
	Seal, set. For C/CR condenser, PTFE, EPDM	027462
	Screw coupling, set. Coupling, pressure spring	048237
	Rubber band. To fasten condenser	032013
	Cross sleeve. To fasten condenser Not included: Rubber band (032013)	027344
	Condenser C. Cold trap, 500m2	040645
	Condenser V. Vertical condenser, 1460cm2	11055921
	Cold finger. For C condenser	000672
	Cold trap mantle. For C condenser	040641
	Stopcock. For C condenser, glass	040628
	Tubing. PTFE, Ø3/4mm, white, 600mm Utilization: Feeding	028096
	Screw cap. GL10	023875

10.3 List of abbreviations

Abbreviation	Meaning
ADR	Accord européen relatif au transport international des marchandises dangereuses par route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
DKD	Deutscher Kalibrierdienst (German Calibration Service)
EPDM	Ethylene propylene diene monomer
FEP	Fluorinated ethylene propylene
FFKM	Perfluoro-elastomer
FPM	Fluorinated propylene monomer
GGVE	Gefahrgutverordnung Eisenbahn (German Hazardous Goods Regulations for Railways)
GGVS	Gefahrgutverordnung Strasse (German Hazardous Goods Regulations for Road Transport)
NBR	Nitrile butadiene rubber
PBT	Polybutylene terephthalate
PETP	Polyethylene terephthalate
PTFE	Polytetrafluoroethylene
RID	Règlement concernant le transport international ferroviaire de marchandises dangereuses (Regulations concerning the International Carriage of Dangerous Goods by Rail)

10.4 Health and safety approval

To guarantee the health and safety of our staff and to comply with the law and the regulations for handling hazardous materials, for the purposes of health and safety at work and safe disposal of waste, no products may be sent back to BÜCHI Labortechnik AG or repaired unless we have received the declaration below, completed and signed.

Products sent to us will not be accepted for repair or DKD calibration until we have received this declaration.

- ▶ Copy the form overleaf and complete it.
- ▶ Make sure that you know the full details of the substances with which the device has been in contact and the all questions have been answered fully and correctly.
- ▶ Send the completed form to us in advance by post or fax. The declaration must reach us before the device.
- ▶ Enclose a copy of the declaration with the device.
- ▶ If the product is contaminated, inform the carrier (in accordance with GGVE/GGVS/RID/ADR).

If the declaration is missing or the procedure described is not followed, the repairs will be delayed. We ask for your understanding and cooperation with regard to these measures.

10.5 Health and safety

Declaration regarding the safety, hazards and safe disposal of waste

To guarantee the health and safety of our staff and to comply with the law and the regulations for handling hazardous materials, regarding health and safety at work, and to comply with safety regulations, health and safety requirements and requirements for safe disposal of waste such as chemical waste, chemical residues or solvents, the form below must be fully completed and signed whenever devices or faulty components are to be sent back to our factory.

Products or components will not be accepted if this declaration has not been provided.

Device	Model:	Part/Device no.:
---------------	--------	------------------

Declaration for non-hazardous materials

We hereby assure that the products returned

- ☐ have not been used in the laboratory and are new.
- ☐ have not been in contact with toxic, corrosive, biologically active, explosive, radioactive or other hazardous materials.
- ☐ are not contaminated. The solvents or residues of the substances pumped have been removed.

Declaration for hazardous materials

In respect of the products returned, we hereby assure that

- ☐ all substances (toxic, corrosive, biologically active, explosive, radioactive or otherwise hazardous) that have been pumped by the products or have otherwise been in contact with the products are listed below.
- ☐ the products have been cleaned, decontaminated, sterilised inside and outside and all inlets and outlets are sealed.

List of hazardous materials that have been in contact with the products:

Chemical, material	Hazard category

Final declaration

We hereby declare that

- we are fully conversant with the substances that have been in contact with the products and have answered all questions correctly.
- we have taken all measures necessary to prevent potential hazards in respect of the products returned.

Company name or stamp:

Place, date:

Name (block letters), position
(block letters):

Signature:

